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- Complete VXI software tools

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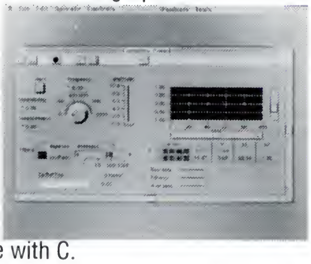
Software	LabVIEW 2	LabWindows 2	Measure	Virtual Instrument
Platform	Macintosh	DOS	DOS	DOS
Acquisition				
GPIB	√	√	√	†
VXI	√	√		†
Plug-In	√	√	√	†
RS-232	√	√	√	†
Instr. Drivers	155	125	31	†
Analysis				
DSP	*	√		†
Statistics	√	√	√	†
Array Maths	√	√	√	†
Curve Fitting	√	√	√	†
Presentation				
2D Plots	√	√	√	√
Strip Charts	√	√		√
Hard Copy	√	√	√	√
File I/O	√	√	√	√

* *LabVIEW has DSP hardware support for high-speed analysis*
† *Virtual Instrument Developer Toolkit can be used with LabWindows libraries*

LabVIEW 2 is a graphical programming system for the Macintosh for data acquisition and instrument control. Users create software modules called virtual instruments instead of writing programs. It has all the power of a programming language, but is easier to use because of its graphical environment.

LabWINDOWS for the IBM, is a set of data acquisition and instrument control software development tools using extended memory capabilities for Microsoft Quick BASIC and C.



Measure is an add-on for Lotus 1-2-3 and Symphony for data acquisition and control. It provides the tools of a spreadsheet.

Virtual Instrument is a DOS-based programmer's toolkit for developing graphical front panels for instrumentation systems. It requires experience with C.

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AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Philips DCC stars at the Las Vegas Show

Philips made quite an impact at this year's Consumer Electronics Show in Las Vegas, reports Louis Challis, with its demonstrations of prototypes for its new Digital Compact Cassette system. See Louis' report on the Show, starting on page 10.

Dual-band whip for handhelds

Here's an easy to build whip antenna for 2-metre or 73cm handheld transceivers. Build it to replace that old 'rubber ducky' – see page 82.

On the cover

Just released, Hewlett-Packard's new HP 54600A and 54601A digital scopes offer 100MHz bandwidth and many other impressive 'digital' features, together with the familiar controls and fast response of traditional analog scopes – see page 36. (Picture courtesy H-P Australia)

Entertainment Electronics

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Projects and Technical

Workstation

News and Comment

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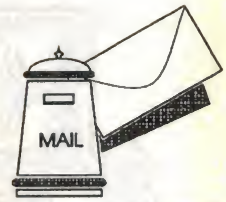
LETTERS TO THE EDITOR



2m transceiver

Congratulations to you and DSE in presenting the latest 2m transceiver kit. I appreciate such state of the art design being made available in this form. I have previously constructed the HF rig with good results; so good in fact that I went out and purchased another kit. As the PA stage is broadband, I figured that all I had to do was build a few mixers using the crystals in the upgrade kits and I would have a multiband trx. However, my attempts at intuitive design of the same have not met with success.

All I have so far is a bin full of discarded home etched boards and feet of used desoldering wick. I shall succeed in the end, but should you ever describe such a band-switching front-end in your magazine, you can count on at least one interestered reader. (A PLL VFO would also be appreciated).

On a philosophical note, I believe that the art of home construction should be preserved along with CW. The facile nature of mere appliance operation does not warrant the allocation of band space.

G. Fisher,
Stepney, SA.

Phone line isolation unit

At the risk of being accused of acting opportunistically, I am able to offer a happy ending to the tale of woe left hanging in mid air in your November issue.

A number of organisations aspire to fortunes through the importation of new and exciting telecommunications products into Australia. The world ends for some of them when the products fail the 3.5kV isolation test. Others, ignorant of the rules (benefit of the doubt!), try to sell products without approval and fall foul of sections 114 and 115, as pointed out by Amanda Davis in her letter to you.

The happy ending is that Pascom Pty Ltd, of Mitcham Victoria, has been manufacturing and selling a range of Austel-approved Line Isolation Units for some years now (albeit quietly).

Models are available for a number of applications, in boxed and rackmounted versions. For companies manufacturing in Australia or those who can influence the designs back in USA, Japan etc, Pascom also has a PCB-mountable device.

Greg Macdonald,
Sales and Marketing Manager
Pascom Pty Ltd.
5 Cochrane Street,
Mitcham, Vic, 3132.

Microbee spares

I read the last letter in the December edition and wrote to Mr Garry D. Hinspeter as follows:

'I read out your letter in *Electronics Australia*' to the meeting of 'MBUG' at Mount Waverley (Melbourne) on Wednesday, and as there was a box of discarded keyboards on the table, it was suggested that if you wrote to our Bazaar Sales, MBUG Australia Inc., PO Box 157, NunawadingVic 3131, saying what model keys you need, we would try to assist...'

All of the Microbee Clubs now have a common monthly magazine and if you want to get it through Cairns and District Microcomputer Users Group, the address is 63 Clarke Street, Manunda, Cairns 4870.

Our club in Melbourne has both Microbee and PC users in it and is very active (subs $24 pa, two meetings a month, RBBS etc.). Microbee Technology Centres (following the rescue by the De Simone brothers) are at Technology House, 186 Lygon St, Brunswick East, Vic 3057 (phone (03) 388 1311). They are now manufacturing the 'Matilda', which can either run CP/M for those who have Microbee programs or PC DOS for those who wish to change.

K. Burke,
Glen Waveley, Vic.

Ribbon re-inker

This has reference to the MAXI-PRINT print ribbon re-inker which you so kindly publicised in the June 90 issue of *Electronics Australia* and we thank you for that.

We would like to take this opportunity to advise your readers that the motor drive unit is now available. The

motor drive runs on 4.5-6V DC and an AD/DC adaptor is included with the kit, together with other accessories. The inclusion of the motor drive unit enhances further the re-inking operation, enabling the user to save time and effort, not forgetting the substantial saving resulting from re-inking ribbons as opposed to buying new ones.

Furthermore, the MAXIPRINT is now capable of re-inking multi-coloured band ribbons. The special feature of the colour ink — know as 'mutual rejection properties — ensures that when two different colour inks come into contact, they will reject each other. Thus overlapping of the inks will not occur. This product improvement gives the Maxiprint a further edge over other ribbon re-inkers.

I am happy to provide further information or clarification.

Yeong Tay, Marketing Manager,
Ribern Pty. Ltd,
1/7 Conder Street,
Burwood, NSW.

Toroidal trap

It was with interest that I read 'Forum in June's edition of *EA*. In particular, Dr X's solution to toroidal transformer hum problems. Your methodical de-bunking of his solution was great!

However, you also made a classical mistake, viz., thinking that his solution was a shorted HALF turn. In fact, it is a shorted FULL turn. (The bolt, chassis and earthing cable complete the turn). In fact transformer turns can have only integer values, i.e., it is not possible to get fractional turns. You can only have either one or two turns, but not 1.5 turns.

By the way, it is possible to get 1/2 turn voltage by drilling a hole through 1/2 the toroid and feeding the turn through that hole. (Assuming you don't destroy the winding that already exists).

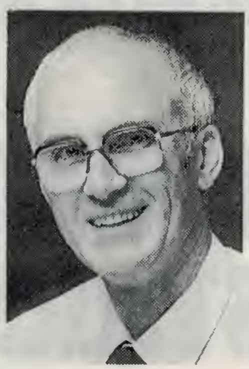
I believe Dr X probably did cure a hum problem with this solution, but the explanation was probably that he happened to create an opposing magnetic field with his shorted FULL turn. His sensitive circuitry was probably located close to his shorted turn.

Peter D. Kay, B.E. Elec.
Glen Waverley, Vic.

DROP US A LINE!

Feel free to send us a letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it. — but we reserve the right to edit those that are over long.

EDITORIAL VIEWPOINT



Making 'user friendly' more than just a claim

The term 'user friendly' has become a bit hackneyed of late, especially when it comes to computer software. To a certain extent it's become something of a 'motherhood' term, with almost every firm claiming that its products have been designed to provide the utmost in user friendliness. Just as they all claim to be 'market driven', providing only the products that the customers have said or shown that they want.

As in many similar cases, the reality often turns out to be rather different. So it's not unreasonable to approach any such claim with a healthy measure of skepticism, I'd suggest. In any case, the only real judge of user friendliness is the end user: you.

But at the same time, the fact that the term has become devalued and misused doesn't mean that the *concept* of user friendliness isn't an important one. On the contrary, it's surely a major goal for *all* product designers — not just for software, but for hardware as well.

What prompted me to offer these comments was the very recent launching by Hewlett-Packard of its new HP 54600A/54601A compact digital 'scopes, as reported in this issue on page 36. At the launch presentation, H-P's R&D project manager explained how his development team had gone to a good deal of trouble to find out the main reasons why many users of traditional 'analog' scopes had tended to shy away from digitising instruments.

It turned out that apart from cost, there were two other reasons. One was that many users were comfortable with the traditional 'dedicated' controls on an analog scope's front panel, but didn't like the kind of softkey-driven menu selection system provided on the majority of digital instruments. And the other reason was that they were irritated by the way there was often a delay between changing a digital scope's controls, and seeing the effect of the change on the display itself.

Needless to say, the H-P team gave a high priority to tackling both of these problems when developing the new instruments. And judging from the end result, they were very successful. The HP 54600A/54601A provide virtually all of the 'extra' scope features that can be achieved using the digital approach, yet at the same time they have the familiar 'look and feel' of a traditional analog instrument. All of the main operating controls are 'dedicated' for immediate access, and the display responds to control adjustments with virtually the same speed as an analog instrument.

In short, the H-P team seems to have achieved a significant and real improvement in the user friendliness of the new instruments, without any sacrifice in their performance or functions. And at a price which compares well with analog instruments offering at least the same basic order of performance...

Hopefully we can see more of this practical, down-to-earth approach to the original concept of user friendliness, from other firms. And congratulations to H-P for this particular achievement, which will hopefully be rewarded by a matching level of user support.

Jim Rowe

DIGITAL TAPE, CD MAPS STARS OF LAS VEGAS CES

Not long back from a visit to this year's Winter Consumer Electronics Show, Louis Challis has now almost recovered from the effects of wall-to-wall decadence and poker machines. He was much more impressed by some of the products premiered at the Show, such as the new Philips Digital Compact Cassette system, Panasonic's new video printer and Blaupunkt's 'Travelpilot' car navigation system using CD-ROM maps. Here's his report...

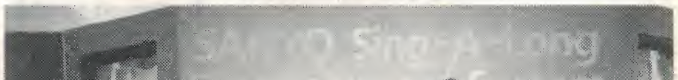
Rome is a wonderful city, with numerous historic ruins that attest to its former glories. Although countless invaders have sought to despoil its monuments, they have survived the ravages of time and wilful destruction to bear mute testimony to the excesses and decadence of the Roman Empire.

It was purely by chance that I visited Rome immediately before travelling on to Las Vegas, and I was struck by visual, architectural and even social parallels between the lifestyle of ancient Rome and that of what I perceive to be its modern day counterpart. It's not just that Caesar's Palace has been modelled on the Pantheon, but rather that the decadence of Las Vegas now appears to be what I would describe as almost an 'art form'.

To consistently select Las Vegas as the venue for each Winter CES leads one to believe that there may well be some ulterior reason for doing so. I suspect that this is associated with the promoters' desire to present new products in a surrealistic environment, where the differences between 'truth and fiction', 'good and bad' and 'new or old' are wilfully blurred.

CES 1991 was larger than life and seemed to defy the economic pessimism which is pervading the USA and most other Western countries. As large as it was, there were fewer important new releases than I would have expected, although some of

On the Sanyo stand, Louis spotted this attractive young lady demonstrating the firm's new 'Sing-a-Long' Karaoke System. She also called for volunteers to try it out....



Nobody else volunteered, so Louis stepped up and gave it a try. Frank Sinatra he ain't, and he probably isn't quite as good looking as the young lady, but it was good fun.

those were of such importance to compensate for the dearth of other outstanding developments.

Philips unveils DCC

By far the most important technological development to be released with fanfare at the CES was the long-awaited debut of Philips 'Digital Compact Cassettes', or DCC as it will be called by the industry and consumers alike. Regrettably a snowstorm in New York delayed me just long enough to miss my connecting flight to Denver, so that I missed the all important official release of DCC.

Undeterred I arranged to attend the media technical briefing session the next day, at which Jerry Wirtz, the technical whiz-kid from Eindhoven provided the first in-depth technical description of the fundamental principles, as well as some of the less obvious limitations associated with the DCC system.

As the technical description unfolded, I was immediately aware of a feeling of *deja vu,* as five years ago I visited Yamaha's factory at Hamamatsu and was shown prototype DAT and DCC cassettes — both of which were being seriously considered by the companies who were in the process of setting the standards, as well as deciding in which order those developments would alternately proceed.

It may be history now, but it's worth recounting that the industry consortium decided (for reasons best known to itself) that the DAT system would be first off the rank, primarily I suspect, because all the fundamental problems associated with its technical development had already been solved by that time.

Now as you may already know, the DAT system uses a rotating head, which lays down the magnetic signal as a series of angled stripes closely aligned across the magnetic media in the miniscule DAT cartridge.

Its recording system and specifically the recording hardware, is based on conventional video recorder technology, which is then used to record digitally encoded PCM signals onto the tape.

By contrast, the DCC system, which is mechanically simpler but electrically far more complex, uses a stationary multiple parallel head to lay down a series of eight unbelievably narrow parallel recording tracks on a narrow magnetic tape, with each channel incorporating digitally encoded PCM data. Whilst the rotating head in the DAT system has sufficient speed to readily compensate for the slow speed of the tape, the DCC system has to adopt an alternative means of transferring the prodigious amounts of digital data onto the tape with the very slow tape transfer speed. Obviously with eight parallel channels the task is eased, however the DCC system has made its trade-off between mechanical complexity in the DAT for what I perceive to be a substantially more complex electronic system, solely to avoid that ubiquitous rotating head.

Louis took this close up shot of a Philips demonstration prototype DCC recorder, together with an array of software cassettes. This demo machine had a transparent panel in the top of the case.

Although the committee which made the decision back in 1986, opted for DAT, Philips had already made a monumental investment in conventional compact cassettes. They earnestly believed that the consumer had made an equally impressive investment in compact cassettes, with trillions of compact cassettes having been manufactured already and billions of compact cassette players already in a billion houses around the world. They expressed the opinion that the planned obsolescence of all those billions of pre-recorded cassettes and players was morally unjustified, particularly as compact cassettes have now reached a standard of performance which more than justifies extending their life. If that approach was not adopted, then we would create a similar problem with the compact cassette to that which we are currently experiencing with LP records. As you may have noticed, they are now fast disappearing from the record stores, and are likely to become 'modern day fossils' within five years.

Philips approach is novel and worthy of approbation, as they wish to promote the parallel development of cassettes, which will be accepted by the new DCC machines — and thereby avoiding financial embarrassment and the despatch to oblivion of an existing system, as the means of promoting a new system.

The idea has merit but warrants a closer examination of the mechanisms through which it will be achieved. The first problem that Philips had to solve was to create a recording head system which would allow them to lay down nine miniscule recording tracks, each only approximately 70 microns wide, and which, with the inter-track gaps cumulatively, have a total width of 1850 microns (1.85mm).

Philips solved this problem by developing a thin wafer head assembly, which is photographically etched onto a silicon substrate using techniques which are basically similar to transistor photo etching. This array is mounted on a flip-over head assembly with two conventional compact cassette heads on the other side of the assembly, thereby providing the compatibility with conventional compact cassette tapes (see diagram).

While the conventional compact cassette player was originally configured on the basis that the user would turn the tape over to gain full use of the tape, it was only late in its development that by-directional record and replay facilities were adopted to simplify its use. By contrast the DCC system is based firmly on the principle that the DCC cassette would be loaded in that one position. Obviously, a conventional compact cassette loaded in a DCC machine would also require no reversal and the machine will automatically determine which format has been loaded in order to select the appropriate heads.

Now Philips faced some rather embarrassing problems, which their technical researchers highlighted fairly early in the piece. The most significant of these was that a DAT

system really does have some important technical advantages over the DCC system, nothwithstanding the adoption of eight tracks (actually nine with the data channel). This is because the bandwidth capabilities of the DAT system are quite outstanding.

Philips devoted an inordinate amount of time into psycho-acoustic research and related electro-acoustic research, through which they could reduce the bandwidth requirements of the system. They even developed a 'precision adaptive sub-band coding' system (abbreviated to PASC), in order to delete slabs of redundant information which conventional DAT and most other tape recording systems most readily accept.

Without involving ourselves in an extended technical discussion (which I intend to address in a later article) it should be stressed that Philips was involuntarily forced to find ways of reducing the bandwidth requirements, if this system was to achieve adequate fidelity and be able to compete on some sort of equal footing with DAT — let alone compete with the most advanced forms of compact cassette as typified by those incorporating the latest 'Dolby S' noise encoding system.

The DCC system has cleverly addressed these multiple issues and simultaneously incorporates the adaptive sub-band coding so that recorded signal energy can be swapped between the eight separate tracks. It can simultaneously share the information using a modified Reed-Solomon code error correction system, and still provide a quality of signal which is comparable with a DAT system, and clearly superior to the latest (and greatest) analog compact cassette systems.

The secret is of course, in the innovative LSI chips that Philips has developed and which they believe will prove cheaper than the competing DAT system.

After the other reviewers left the gathering, I auditioned two DCC systems with pre-recorded DCC cassettes, and by and large was impressed with the fidelity that this system provides. I visibly winced as two very significant drop-outs occurred, whereupon Mr Wirtz quickly pointed out that this was still a developmental system and that Philips' development work was not yet complete.

Based on my observations of the equipment being displayed, the presence of three obviously different versions of the prototype DCC cassettes (which I admit puzzled me), and the comments that were made in respect to the emphasis being placed on appearance (which tended to be discussed more than engineering development), it was apparent that the Eindhoven development engineers had been pushed into demonstrating a system whose technological development is by no means yet complete, nor wrapped up ready for selling.

DCC requires extremely complex LSI's, and although we were told that the prospective marketing price in volume would be comparable with an upmarket compact cassette player, I do not believe that such promises will be readily met until at least five to eight years following their official release date. Although Philips has not announced when that official release will take place, I doubt their ability to deliver the DCC to the marketplace before the middle/end of 1992.

Nothwithstanding my qualms, DCC does seem to have the potential to beat DAT 'into a cocked hat', as most consumers will be attracted by its compatibility with their existing compact cassettes — and particularly in the automotive sector, where I believe compact cassettes with or without DCC, will continue to be the preferred medium for many years to come.

Sony's DAT

After leaving the DCC technical meeting, I progressed to the Sony stand where I examined the latest Sony DAT recorders including the DTC-55ES, which is a conventional mains operated DAT recorder, and the battery operated TCD-D3. Both of these have now been officially released on the USA market. The more exciting of these is the Sony TCD-D3 'digital Walkman,' which offers both record and playback capabilities in a battery operated machine no larger nor heavier than the first generation Sony Walkman of 11 years ago.

Not surprisingly, AIWA (which is a Sony subisidary with independent management) unveiled its HS-V2000 portable DAT/still-video recorder system and the HD-X3000 portable DAT recorder which they claim is the world's smallest and lightest professional DAT recorder in the world.

Sony's TCD-D3 digital Walkman, a complete record-play DAT machine in surprisingly compact form.

The technical capabilities of all three of these machines are 'mouth watering'. The MMD-100 still video/DAT recorder features a random access RS-232C interface, with four-digit address codes that provide almost instantaneous storage and retrieval of a broad range of audio and video outputs on demand. The unit can provide outputs to feed a broad range of portable LCD TV's, video monitors and video printers so that images can be 'hard copied' on demand.

The AIWA HD-X3000 weighs less than 900 grams and if not the smallest, is most certainly the lightest professional DAT recorder currently available.

Onkyo released its own DT-9000 digital audio tape deck, with serial copy management system incorporated, which at US$1100 was particularly attractive and which places it firmly in the same market as Sony's.

While in London and New York earlier in the week, I had enquired about the availability of pre-recorded DAT's. Even though Sony had released its model DTC-55ES in London, New York and Australia, not one of the large record shops which I entered had any pre-recorded DAT's for sale. The typical asking price for pre-recorded DAT's from special outlets or magazines is currently much higher than the selling price for premium CD's. Although that situation may change, I believe that those people who do purchase DAT's will primarily do so to assist them in professional recording and not for dubbing CD's, as this will prove to be a most expensive way of illicitly copying software.

Video printer

An associated item of equipment that is worthy of description is Panasonic's remarkable new video printer, which will provide still pictures off your TV screen. The Panasonic PV-VP1 video printer is capable of turning out brilliant colour still pictures from almost any video source.

This provides the ability to reproduce photographic images from camcorders, video tapes, laser discs and a range of laboratory equipment with all the vivid colours and matching video definition. It provides the wherewithal to scan through recorded material and cull the most interesting prints out of a range of available material, in a way that you could not match with a still camera. With a suggested selling price of US$1300, this may possibly prove to be one of the

most interesting and newsworthy 'oddball consumer' items released at the 1991 Winter CES.

Cassette systems

The first of the Harman Kardon cassette decks incorporating 'Dolby-S' noise reduction systems were being shipped to dealers as the CES was opening. The TD4600 and TD4800 cassette decks, which I heard, were mighty impressive and had noise figures which are claimed to be 4dB(A) less than the previous generation of Dolby-C decks. With the demonstration material provided, I could not detect background noise and the signals appeared to offer superior fidelity and a worthwhile enhancement in terms of transient performance. These two decks were not cheap but are still cheaper than the comparable second generation DAT recorders which are now available in the US (and Australian) market.

EIA campaign

The next most important technical issue, as opposed to a product, at the CES was the Electronic Industries Association campaign whose theme is 'We Want You Listening for a Lifetime'.

The logo being used by the EIA to promote its awareness programme on the dangers of hearing loss.

This is a planned, year-long national service campaign to make the public aware of the issues of hearing loss and to promote safe usage of electronic entertainment equipment. Their reasons for doing so is their knowledge that there are currently 28,000,000 hearing-impaired people in the USA, approximately 10,000,000 of whom are believed to have been associated with exposure to high intensity (loud) sounds.

Based on my own investigations, an unreasonably large proportion of the Australian population already suffers significant hearing impairment, and it would appear that too many of the younger people in our community have inadvertently exposed themselves to excessive sound levels as a result of playing or listening to unacceptably loud music.

We too need a programme or campaign to educate our youth, and with your help we may succeed in getting it off the ground.

I noted with interest that the American record for the peak amplified sound level in cars and vans was already 2dB higher than it was last year, and that the subwoofers and multiple speaker arrays available for general use were still progressing even further in the wrong (extremely dangerous) direction.

Not so surprisingly, there is a culture and comprehension gap between those people marketing what I regard as potentially dangerous products and the population placed at risk by those products, few of whom (on either side) comprehend the magnitude of the dangers to which they expose themselves.

Big screen TV

Once again the home video and home theatre fields assumed a dominant role at the CES, particularly in terms of the American market. Foremost amongst these was Toshiba's 'Super Tubes', which are 1175mm video tubes designed for both conventional (NTSC) and high definition television formats, both of which were strikingly evident on many of the stands.

The Japanese high definition television formats are being firmly pushed as the next and most exciting contender for the American 'home theatre' market, and that will be the primary area (if not the only area) of their real impact.

In Australia, the Japanese high definition television is unlikely to make as strong an impression as will the European 1250 line/625 line compatible high definition television system, which I believe will become the new wave in this country in approximately four years' time.

Small screen TV

At the other end of the spectrum Casio released its TV-470 hand-held colour LCD TV with a 55mm screen and with a rounded case design, which makes it small enough to fit in the hand and carry anywhere. With a recommended selling price of less than US$200 and a high resolution colour liquid crystal display based on

Casio's new TV-470, a hand-held colour LCD TV with 2.2' screen.

new technology, this probably constitutes the ultimate development in personal portable TV. The unit will operate off four 'AA' batteries, from a car cigarette-lighter dashboard supply, or from an external AC adaptor and will revolutionise portable TV watching when it finally reaches Australia.

Camcorders

Video 8mm camcorders have made outstanding progress in the last year,

JVC's most compact VHS-C camcorder, the GR-AX7. It weighs only 760 grams.

and there were numerous examples of advanced 8mm equipment, the most outstanding of which was typified by the Canon L1 system, the smallest, lightest and most impressive professional/consumer video recording system to be released at the Show.

Canon has the lens business sewn up, and their L1 recorder which accepts a range of different lenses is worthy of a design award: undoubtedly it will receive them.

Here is a system which has absolutely everything, including a range of digital effects which have the pizazz of a professional recording suite, but for the first time built into a relatively small camera. The 0.5 lux light capability means that this camera can be virtually used in the dark (provided you have the appropriate wide aperature lens and 1/8th shutter speed), and the pictures that I saw produced with the Canon L1 camera were generally better than professional videos than I had seen produced with cameras ten times the size.

At the same time, JVC released the 'ultimate' palm sized VHS-C camera, their new model GR-AX7 which weighs only 760 grams. Although neat and small, Sony's model CCD-TR45 is still smaller.

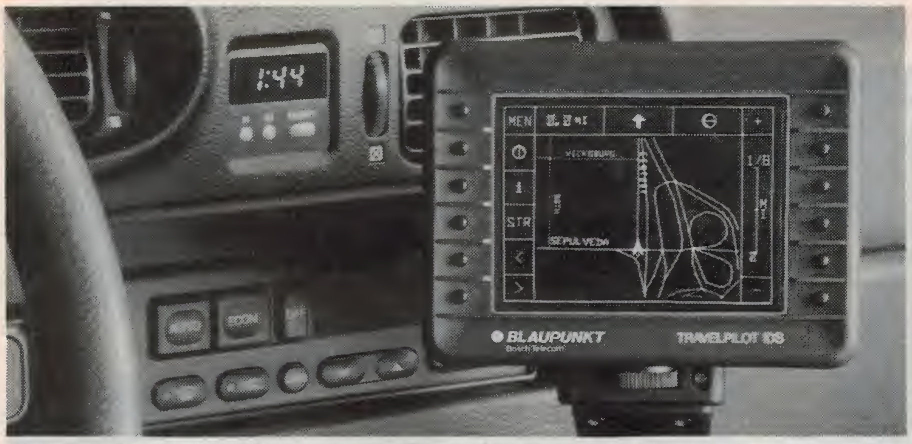
The front panel of Sanyo's EX-W2 voice-recognition mobile audio system, which can memorise 20 spoken commands to control the tuner, cassette player and CD changer. It also includes a seven band spectrum analyser.

CD technology

CD development, although significant in terms of the quality of the products being offered, was dominated by the inroads of one-bit CD players into what had previously been a very conventional discrete 18-bit player field.

I was also impressed by the extent to which multi-disc players are now usurping single disc players as the preferred format for home high fidelity players. Nakamichi clearly has only a short time edge on its competition with the CD player 2 and player 3 systems, which incorporates its MusicBank system.

Surprisingly, Nakamichi has not adopted a one-bit system, but has adapted enhanced linearity 20-bit D/A converters with 8-times oversampling, associated mechanical storage stacks and silent running mechanisms, which have been extremely well received by the market and reviewers, alike. Competing against



The display screen of Blaupunkt's 'TravelPilot' vehicle navigation system, which is based on road maps recorded on CD ROM discs.

this product is Pioneer with its new proprietary 'Stable Platter Mechanism', which uses a heavy aluminium platter and non-resonant mat to support the entire disc surface during rotation. Like Nakamichi, Pioneer has adopted a disc clamper, which is lowered from above to secure disc placement, together with an ultra-large, brushless spindle motor based on Hall-Effect technology. This development has been incorporated into Pioneer's new 'Elite Product Line' as well as into just one of its CD standard product lineup. After spending much of the last year criticising one-bit players as being inferior to conventional 18-bit linear D/A converters, Onkyo stopped maligning the opposition and released its DX-C201 five-disc carousel type changer. This is a one-bit machine, together with its DX-C310 and DX-C510 six-disc magazine type changers, both of which incorporate 18-bit D/A linear converters.

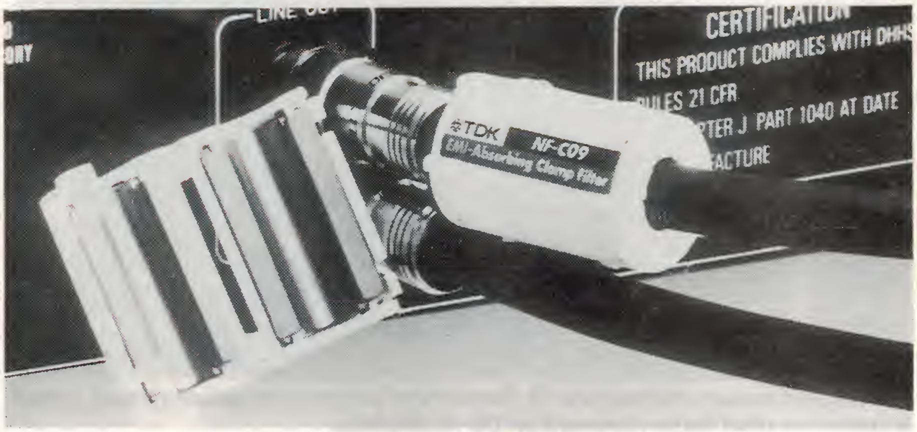
Harmon Kardon also released its first five-disc carousel CD player with 'bit stream' D/A converters, full remote controls and whose specs and matching prices will undoubtedly win them a sizeable share of the market.

Sharp was stressing the advantages of CD changers compared with CD players, and released its CMS-R300 five-disc changer — also calculated to win them a share of this growing market.

Auto electronics

In the car audio field the most outstanding development was Sanyo's introduction of the world's first 'voice-recognition' mobile audio system. The EX-W2 is capable of memorising 20 voice commands for the control of the tuner, cassette and CD changer, but Sanyo provided only limited glimpses into the powerful technology. The unit is pre-programmed to respond to vocal commands such as 'tuner, preset 1', or 'tape, fast-forward, play'. The initial programming of the system, so that it recognises the user's voice and specific commands, is accomplished by speaking each of the 20 available programmed commands into the supplied microphone in a pre-determined sequential order. If the command is spoken clearly and accepted, then the unit acknowledges its acquisition by responding with two beeps, after which the next function button lights up for programming. The designers have taken into account the strong possibility of the unit's theft and have ingenously incorporated a password which inhibits the new (unauthorised)

Las Vegas CES



TDK has released a range of digital noise absorber filters which clip over cables and eliminate interference from digital signal harmonics.

owner from re-programming the voice commands in the absence of that spoken password.

Security and particularly car security was once again a major feature at the CES this year. Everybody, but everybody around the world is now stricken with the problems of vehicle theft and mobile audio theft, and there were more new firms with exciting products and matching catchy names available than I have ever seen before.

Well known firms like Crime Stopper, Invisibeam and Black Widow were matched by the big names in hifi and car stereo — Kenwood, Sony, Panasonic, Sanyo, Clarion, Pioneer and Alpine, all of whom were offering superior car theft technology to that which they displayed only last year.

One outstanding electronic car product which is worthy of mention was Blaupunkt's 'Travelpilot' car navigation system, which was being launched in the USA for all those areas for which CD-ROM maps are currently available.

CD-ROM maps have been available in many cities in Europe since 1989, and have recently become available for the New York metropolitan area and of course for California which is potentially an even bigger market.

The Travelpilot system provides the most functional and effective alternative to a conventional road map or street directory that I have yet seen, and does not require satellites, buried wires or any special radio network to show you your current position — as well as your direction of travel on a video map display screen.

Travelpilot uses an electronic compass and dual wheel sensors to actually measure direction and distance. This is coupled to an artificial intelligence which Blaupunkt's engineers have called 'map matching', through which the vehicle's movements are constantly evaluated and compared to the known road map. Each time the car moves and changes direction the movement is compared to the map and the car's position re-assessed to accurately conform to the map.

With a suggested price of US$3500 and CD-ROM maps at less than US$100 each, this will obviously prove to be a new 'status symbol' in the USA.

The last product which I saw and which I believe will be of interest to consumers and professionals alike, is TDK's 'Digital Noise Absorber'.

This is a 'snap-on' ferrite filter clamp assembly which slips over the end of signals and power cables to attenuate spurious and unwanted electro-magnetic signals of the type generated in DAT recorders, and other equipment incorporating VHF or UHF digital signals.

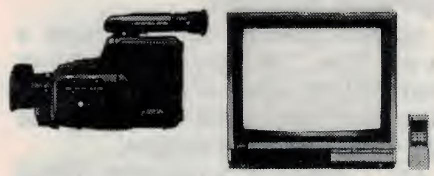
Although TDK has not acknowledged it, this development embodies theoretical principles which were originally researched by the US National Bureau of Standards in the late 1940s.

NBS found that unwanted RF and video signals can be effectively minimised at the points of cable exits from, or alternatively at, their termination points into other equipment — where the outer screen, or unscreened wires are carrying spurious and unwanted high frequency circulating currents. In theory, those screened cables are self protecting, whilst in practice, they are far from it.

Based on the technical information provided by TDK, it would appear that the NF-CO9 will prove to be a very useful adjunct in many hi-fidelity situations.

Based on my experience, it will also prove to be even more effective and beneficial, in a wide range of professional computer, as well as RF, VHF and UHF signal transmission applications, which TDK may not yet have envisaged. ■

What's New in VIDEO and AUDIO



Yamaha releases Karaoke player

The new Yamaha CDV-1200K Laser Disc Karaoke Player offers a wide range of features designed to enhance its entertainment potential. These include digital surround sound; a 'key control' which allows the replayed music to be adjusted through 17 different musical keys (8 steps sharp/8 steps flat); the ability to change the pitch of your voice, for special effects; automatic changeover to the recorded vocal, when you stop singing; twin microphone inputs, with adjustable digital echo; a 'once more' button, to replay the last five seconds; and a choice of stereo, multiplex or stereo multiplex operation, with a balance control to adjust music/vocal balance.

In addition to playing both multiplex and stereo digital karaoke laser discs, the CDV-1200K also plays standard 80mm and 120mm audio CDs, CD-Video discs and 200mm/-300mm laser video discs. These can all be used for karaoke playback, by using the one-touch karaoke button to mute the recorded vocals. Other features include direct accessing of up to 20 recorded songs, programmed playback of up to 15 tracks and a multi-feature infra red remote control. Recommended retail price for the CDV-1200K is $1499, but this does not include microphones, power amplifier or speakers.

For further information circle 181 on the reader service coupon, or contact Yamaha Music Australia, 17-33 Market Street, South Melbourne 3205; phone (03) 699 2388.

Hitachi 'midi' systems feature comprehensive remote

Hitachi has released two new exciting 'midi' hifi systems, both of which incorporate infra red remote control, with model MD400 featuring full function remote operations of all components excluding the turntable.

Many useful automatic editing functions have been incorporated into the MD400 to enhance overall operational versatility.

Synchronised compact disk to tape deck recording to arguably one of the most beneficial functions to be offered, with a variation of automatic and manually controlled fade in/out operations. Model MD300 incorporates AM/FM stereo digital tuning and a 60-watt RMS amplifier driving two way midi size tower speaker boxes.

The MD400 incorporates a separate component digital tuner with timer recording mode, and a 100-watt RMS digital surround sound amplifier driving three way bass reflex speakers.

For further information circle 185 on the reader service coupon or contact Hitachi Sales Australia, 153 Keys Road, Moorabbin 3189; phone (03) 555 8722.

Hybrid ribbon speaker system

Apogee Acoustic has introduced a new line of hybrid ribbon loudspeakers which it claims features the best of both ribbon technology and conventional woofer designs.

The Centaur is a two-way hybrid speaker that employs a 26" line source dipole mid range/tweeter ribbon unit that is claimed to be ruler flat to beyond 20kHz, plus an 8", long throw polypropylene driver supported in an acoustic suspension enclosure.

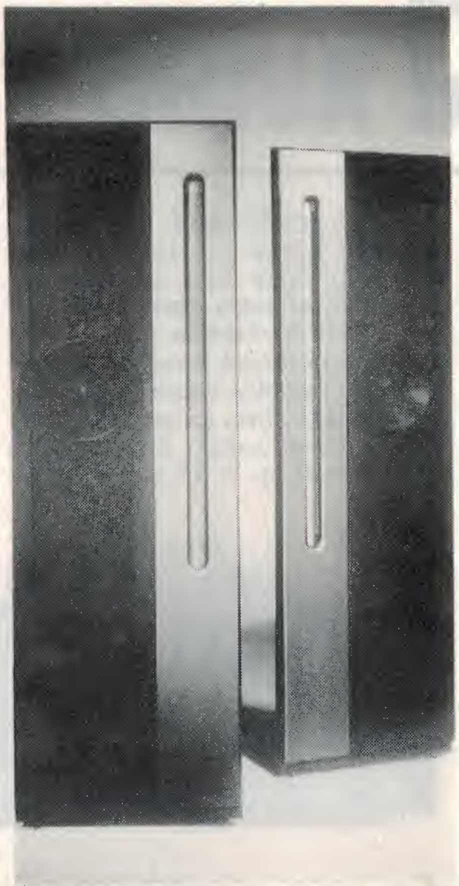
The woofer enclosure is 0.75 cubic feet, sealed and has been designed for maximum low frequency linearity to below 38Hz.

Heavy internal bracing is employed for minimum cabinet vibration and colouration and the woofer takes over from the ribbon elements via an impedance compensated 12dB per octave crossover.

Apogee has used an injection-cast magnesium frame for rigidity and a mineral filled polypropylene cone with high loss rubber surround for improved bass driver linearity and transient response. The voice coil is 1.5" in diameter.

The Centaur has a recommended retail price of $3995 and is covered by a three year warranty.

For further information circle 182 on the reader service coupon or contact Kedcorp Pty Ltd, (02) 708 4388.



Sony 'phones for CD listening

Sony has developed four new models for its popular MDR-CD series of digitally matched stereo headphones.

Designed for demanding listeners who prefer a closed type headphone, the series will handle all the dynamics of CD sound as well as the subtleties contained in any traditional high-fidelity music source.

A special diaphragm incorporated into the MDR-CD series reproduces the original sound with extremely high fidelity, providing powerful bass notes and crystal-clear trebles that are unobtainable with a conventional film diaphragm.

A ceramic composite baffleplate contributes to the crisp sound and prevents distortion by firmly supporting the diaphragm. Long wearing comfort is also assured by the newly-designed wide headband.

Flagship of the range is the MDR-CD999 Digital Monitor, a dynamic circum-aural closed-type stereo headphone which boasts an amorphous diamond-plated diaphragm with a 50mm driver unit to reproduce powerful, unadulterated sound.

At the budget end of the range is the MDR-CD33 which features a titanium diaphragm, a ceramic composite baf-

New Sanyo system has separate woofer

Sanyo has just released its SF6 system, which produces a whopping 550 watts of peak music power (85 watts RMS total) and uses new speaker technology to faithfully reproduce the very low and powerful bass frequencies that give so much realism to any music.

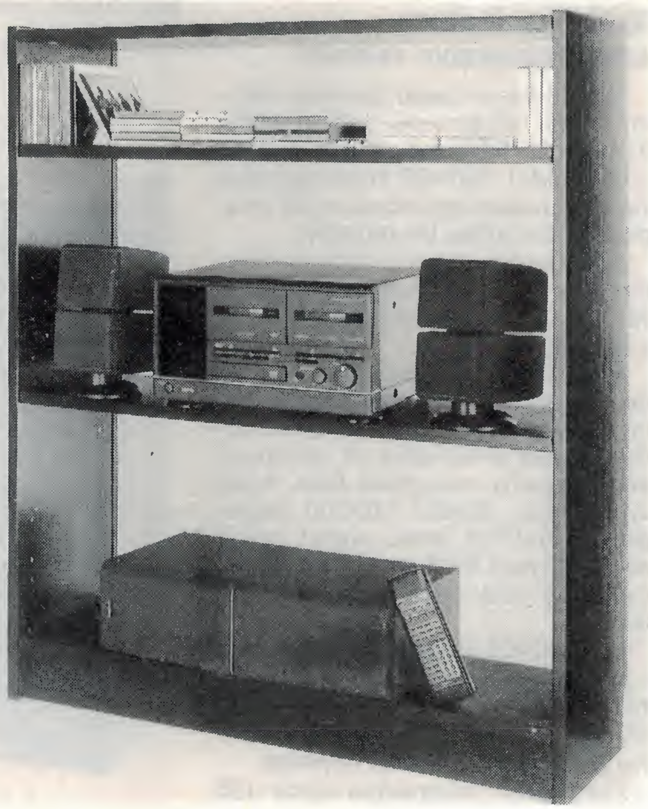
Unlike most stereo systems which use two amplifiers — one for left and one for right stereo channels, the SF6 uses a third and separate amplifier to drive a common bass speaker.

The SF6 also has Sanyo's fully computerised recording system (FCRS). This system overcomes problems associated with dubbing from CD to tape, where the tape ends before a CD track is finished. It also reschedules play order off a CD to completely fill side A of a tape — no more blank patches!

For those who want to integrate their sound system into audiovisual home entertainment centres, the SF6 has facilities to connect your television and VCR. This creates a control centre for audio and visual units where you can switch audio and visual signal simultaneously.

Further features include a CD player and twin auto-reverse tape decks, with a 49-key full remote control.

The SF6 is available now from selected retailers throughout Australia at a recommended retail price of $1899.



fle plate, three-metre Litz cord and Unimatch plug.

For further information circle 183 on the reader service coupon or contact Sony Australia, 33-39 Talavera Road, North Ryde 2113; phone (02) 887 6666.

BASF acquires Agfa tape business

Giant magnetic tape manufacturer BASF seems set to further strengthen its leading position in the Australian audio-video tape market.

This follows the recent announcement in Germany that BASF has acquired Agfa's magnetic tape business, with an estimated worldwide turnover of almost $500 million. Combined annual sales of BASF and Agfa magnetic tape products will exceed $2 billion, making BASF one of the world's largest suppliers of magnetic tape. From January 1, Agfa's magnetic tape range, manufactured in Europe, is continuing to be available under the BASF umbrella. The new BASF-Agfa product range will cover three markets: consumer products — audio and video cassettes; professional products — tapes for TV, radio, recording studio, the duplication industry, and reference tapes; and data media — computer tape, cartridges and diskettes.

Agfa Australia staff are being integrated into BASF Australia.

New midi system from Akai

As a follow on to its M-373 midi system, which achieved record sales in the under $800 price point, Akai has introduced a bigger brother — the M-393. The heart of the system is the amplifier/graphic equaliser that offers 30/30 watts/channel and up to 300/300 watts on instantaneous peaks. A mechanical motorised volume control is employed together with an inbuilt five way graphic equaliser.

A phase locked loop (PLL) synthesised AM/FM stereo tuner offers a total of 12 pre-set stations, six FM and six AM. Also an 'Auto Tuning' feature enables next station search (up or down). The double cassette deck offers a continuous listening mode for uninterrupted music, both normal and high speed dubbing and a 'synchro' recording feature. A separate automatic turntable offers a DC servo drive motor for greater accuracy and stability and provides two speed belt-driven operation (33 and 45rpm).

The compact disc player is a 16 bit, twice oversampling digital filter unit offering up to 16 programme selections. The M-393 has a recommended retail price of $899 and has a 12 month warranty. It is available at Akai dealers and selected department stores.

Economy surround sound receiver

As a follow on to its well received TX-SV90 PRO surround sound audio/video receiver, Onkyo has released a 'little brother' to that model, the TX-SV50 PRO Surround Sound Receiver.

The TX-SV50 PRO incorporates many of the features of the TX-SV90 including Dolby B pro-logic surround sound, Hall Surround, Matrix Sound, a 30-station quartz synthesised AM/FM stereo tuner and surround sound amplifier, plus a multiple room remote system.

It also incorporates a true active digital Dolby B pro-logic surround sound system, similar to that used in some of today's best cinemas, and is not to be confused with many 'passive' type systems found in conventional surround sound receivers.

Incorporating a total of four separate power amplifiers, the TX-SV50 PRO will provide 70 watts RMS per side for the front speakers and 30 watts RMS for the rear speakers, creating four channel surround sound. A fifth channel pre-out can be connected directly to stereo CTVs (with A/V inputs), thus providing the important centre channel.

The TX-SV50 PRO has a recommended retail price of $1299 and is covered by a five year parts and labour warranty. It is only available at at selected Onkyo dealers.

Video product profile:

The VCR that cleans its own heads

As with many of the new Hitachi VCRs, the VT-F778E(AU) incorporates a novel mechanism to automatically clean the video heads each time you play or record a tape — neatly obviating the vexed question of when, and how, you should clean the heads yourself. It also provides exceptionally flexible remote control facilities.

by LES CARDILINI

How often should you clean the heads in a VCR? Perhaps a more important question is 'how do you know when the video heads need cleaning?'

Dirty video heads generally make the picture appear snowy or streaky. When these symptoms appear, then applying a head cleaning tape may well be worth the effort. But it pays to first be fairly sure that the problem is with the VCR, and not the TV set or the antenna. Depending on the type of head cleaning device you use, you could inadvertently be doing more harm than good — especially if you use it too frequently.

Playing a prerecorded video cassette, say a video movie, should help you decide whether or not the fault is in the VCR. If the quality of the prerecorded video picture seems normal then it would be reasonable to assume that the video heads are doing their job satisfactorily — in which case cleaning them would be more than likely a waste of time.

A trap for the unwary when cleaning the heads in a VCR is that, unlike the relatively large and robust metal heads on audio cassette decks which can withstand a degree of rough handling, the tips of the video heads in a VCR are made from wafer-thin ferrite and are easily broken. In normal use the brittle ferrite tips are protected within the head drum assembly — a bright shiny cylinder-like part that is visible through the loading compartment door, on most VCRs. During normal playing and recording the tips of the heads only rub against the smooth surface of the videotape.

Abnormal stresses on the ferrite can damage the tip and instantly render a head useless. Hazards include threads in a cleaning cloth catching on the head, or when too much pressure is applied in attempting to clean the head manually. In fact, the knife-sharp edge that is characteristic of a broken video head might also permanently damage videotapes subsequently played in the VCR before the broken head is replaced.

Head cleaning devices and fabrics typically have a chamois texture, so that there are NO threads to catch on the heads and other sharp parts of the VCR, and to avoid leaving behind lint which in time may foul bearings and other parts of VCR mechanisms.

A more pressing reason to keep the heads and head drum clean, however, is that lint particles might adhere to the videotape and cause severe picture dropouts — especially if they get between the tape and the head while the tape is playing or recording. Minor dropouts in a VCR usually show up as random bullet-like streaks on the screen. Severe dropouts wipe out large areas of picture, momentarily.

In some cases the lint will fall out of harm's way to the base of the VCR but equally it can stick to the tape and find its way into a videocassette.

Perhaps it helps to know how the heads get dirty in the first place. A video head has a slit or gap in its ferrite core and tip, filled with non-magnetic glass or similar. For the head to operate efficiently, the tip gap must remain in close contact with the tape. In practice, however, the tip may become covered and 'clogged' with magnetic powder stripped from the tape as it rubs against the head while it is playing. The clogging is what we refer to when we say the heads are 'dirty'.

The heads themselves are not large and the gaps are microscopically small — so oxide deposits, small enough to be invisible to the naked eye, can affect their performance. The problem can arise suddenly, or might build up slowly over a relatively long period.

Having dirty heads, then, does not mean necessarily that the VCR itself is faulty in the general sense. What is more it can happen with all VCRs — new and old, alike — so it would not pay to get uptight if your new VCR has dirty heads or if the heads become dirty soon after a set has been repaired. In fact, the problem might even reappear immediately after the heads *have* been cleaned, although if this happened regularly then it might be grounds for changing brands of tape — or at least having the VCR serviced.

The picture from a VCR that has dirty heads typically will become streaky and snowy or may disappear altogether, depending on how much oxide sticks to the tip of the head and how tightly it packs over the gap.

Some video enthusiasts are fortunate enough to never have been inconvenienced by dirty heads. But if it does happen, then the job of cleaning them might be better left to an experienced technician, especially when the oxide is packed tightly and requires a little elbow grease to remove it. Besides, other parts of the machine such as the drum, belts and pulleys might also be in need of similar attention.

Most ordinary head cleaners fall into one of two categories: wet or dry. Both require care in their application.

A wet cleaner, for example, uses a solvent to remove contamination from the heads. While wet cleaners tend not to abrade the video heads, several minutes should be allowed for the sol-

The Hitachi VT-F778E(AU) recorder, featuring not only automatic head cleaning but also a very flexible remote control unit.

vent to dry out before playing a tape in the VCR. This will ensure that the solvent does not damage the tape.

Dry video head cleaners are typically abrasive and scrape the contamination from the head. Of course, once it has cut through the grime then the abrasive cleaner can grind down the ferrite tips of the heads if the cleaning continues too long. Careless, excessive use of some abrasive head cleaners can reduce significantly the life of the video heads in VCRs.

Hitachi's new approach

A new approach — an automatic, head cleaning system located *inside* the VCR — was introduced perhaps for the first time here about 12 months ago by Hitachi, in its VHS Video Deck Model VT-M728E(AU). Since then Hitachi has featured its head cleaning system in other models, including the VT-F748E(AU) Video Deck which was acclaimed as 'VCR Of The Year' in the non-portable VCR category of the Consumer Electronics Suppliers Association's 1990 Sound and Image Awards.

Hitachi's automatic head cleaning mechanism employs a roller that has 80 fine layers of a special cleaning fabric, that literally gobbles up head grime and traps it below the cleaning surface on the roller. A spokesperson for Hitachi in Melbourne claims that the multi-layered fabric should last for the life of the VCR in normal use, without losing its cleaning efficiency.

The head cleaning mechanism activates automatically for a brief period each time a videocassette is inserted into or ejected from the VCR, and whenever the Operate button is switched On or Off while a videocassette is loaded in the set. This ensures that the video heads are cleaned before each tape begins and again after the tape has finished playing.

During the cleaning cycle the soft, dry, lint-free roller also presses against the spinning head drum to remove grime left on the drum by, say, another videocassette.

One of the main difficulties with having dirty heads in VCRs and for that matter tape decks generally, is that grime begets grime. Oxide deposited on the heads tends to increase friction between the head and the tape and, in turn, more oxide comes off the tape and so the process continues, packing the oxide tightly onto the head.

Removing potential oxide buildup on the heads, using a non-abrasive cleaner before and after each playing, should therefore help to reduce the likelihood that heavier contamination will occur.

For those (it is hoped infrequent) occasions when the heads might get dirty despite the preventive cleaning cycles each time a tape is played, you can use the HEAD CLEANING push- button on the front panel of the Hitachi head cleaning VCRs. Pressing this button initiates approximately 20 seconds of head-cleaning action, after which a tape can again be played to test the success of the cleaning operation.

I caught up again with Hitachi's innovative, self-head-cleaning system when I recently put the new, VHS Model VT-778E(AU) through its paces.

Uncluttered panel

The front panel of the VT-F778E(AU) Auto Head Cleaning Digital Hi-Fi Video Recorder is strikingly simple and uncluttered. In fact, all you see at first is the clock-timer display and stereo sound level indicators behind a flush glass panel.

The more-frequently used controls for operating the VCR and presetting the required local television channels are located behind a small hinged cover to the right of the display. Stereo audio level controls and channel mixing, and the head cleaning push-button are also tucked away, out of sight behind the panel cover. As far as controls are concerned everything else is on the 'smart' hand-held infrared remote unit.

The infrared remote control, too, tends to protect you from an unnecessarily cluttered view of the controls, permanently exposing only those push-buttons you might need in the normal course of operating a VCR or television set. The remainder, concerned with clock setting, forward programming of the VCR, timer settings, manual television channel selection, and so on, are hidden behind a snap-shut door which has a small window through which the current date

and 24-hour time of day can be seen in the liquid crystal display underneath.

The infrared remote unit is surprisingly friendly, considering it has 43 buttons and switches (not counting the partially hidden Reset — to be used on those odd occasions when computers and like systems take things into their own hands and need to be brought back into line).

And for those who are inclined to sigh, 'not ANOTHER remote control in the system' the Hitachi Remote Control Transmitter model VT-RM773E supplied with the VT-F778E(AU) is also pre-programmed to operate 10 different TV sets. If yours is listed in the handbook, then all you need to do is enter the appropriate code and then use the Hitachi remote control to operate both the VCR and the TV set. In fact, the VT-RM773E can be switched to work in a system with two VCRs and a compatible TV receiver.

A code-entry system on the remote can also be used to disable the pushbuttons on the VCR. In this very practical Mode-Lock state the VCR can be operated from the remote, but not from the VCR itself — just the thing if you feel the set might be interfered with while making an important recording. You simply put the VCR into Mode-Lock and make sure nobody interferes with the remote control — keep it in your pocket.

On-screen display

An On-Screen Display (OSD) feature in the VT-F778E(AU) may be activated from the remote during regular program viewing, to superimpose current information about the video system such as which channel is selected, VCR mode, time and date. The On-Screen Display can also be used to assist in the composition and editing of short alpha-numeric titles or messages, using the remote control as a keyboard. The title or message may then be superimposed on the beginning of a recording, if desired.

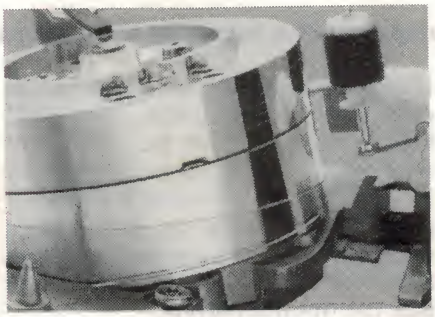
The MENU screen of the On-Screen Display provides access to other options. These include reviewing VCR programming information you have stored, such as time, date and channel.

If English is your second language, you can change the On-Screen Display to appear in German, Italian, French or Spanish, by pressing a few buttons.

Via the Menu screen you may elect to record the time and date at the beginning of each video recording made on the system, activate recording alarms or have the VCR acknowledge pushbutton operations with a friendly 'beep'.

And for added realism in video movies and TV shows, especially in stereo, the BASS boost option in the VT- F778E(AU) can be switched in at the remote to boost or restore some of the exciting street rumble and traffic sounds often lost on the smaller speakers typical of many TV sets.

The set's built-in timer caters for preset recording of up to eight programs for a 1-year period (including those recorded on a daily or weekly basis). The details for up to four regularly recorded TV program spots can be stored in the remote memory as the need arises, and transmitted via the infrared remote control to reprogram the VCR as often as required. As well, should you wish to confirm that an important recording gets away to a good start, an audible alarm in the remote control can be set to sound when the preset recording is scheduled to commence.



The auto head cleaning system involves a roller with a surface of cleaning fabric, which is applied when a tape is loaded or unloaded.

Digital Automatic Tracking is used in the VT-F778E(AU) to ensure the heads pick up the best signal from the tape to optimise picture quality. The tracking system can be adjusted manually at the remote control to cater for tapes recorded in other VCRs, for example, and to eliminate vertical jitter or noise bars when the VCR is in the Still or Pause mode.

The VT-F778E(AU) is set at the factory to remodulate on UHF channel 37, but may be adjusted between UHF channels 34 and 42, for optimum reception in the presence of local channels nearby on the UHF dial, depending on location. A test signal is provided to assist with setting up and fine tuning the required AV channel.

All channels from 1 through 69 are pre-tuned in the VT-F778E(AU) and it was only after I experienced some difficulty in finding channels 2, 9 and 28 that I discovered our local Channel 2 came in on channel 4 in the VT-F778E(AU) and Channel 9 on channel 8 — not a big problem when you find out, but rather frustrating in the meanwhile!

Reserved channels

My attempts at storing our local Channel 28, too, were at first thwarted by the fact that channels 25 through 29 on the VT-F778E(AU) are reserved exclusively for use with Pay Television systems. A Euro-connector socket is provided on the back of the VT-F778E(AU) for connecting a Pay-TV decoder should you want to take advantage of this facility.

Channel 28 was able to be tuned in without further ado, however, and could be called up on any position outside the 25-29 range, and viewed without difficulty.

Apart these minor hiccups, which probably reflected the global state of television channel allocations rather than a fault in the set, the VT-F778E(AU) performed admirably both for regular operation and in the variable speed Slow Motion and Still modes.

The VT-F778E(AU) is fully compatible with Australia's stereo/bilingual television system and the VCR will record stereo sound in traditional longitudinal tracks or in Video Hi-Fi stereo with virtual compact disc quality and dynamic range. Stereo RCA connectors are provided for playing back or recording sound from external sources, and integrating the VCR into stereo and surround sound systems as a hi-fi audio deck in its own right, if required. The VT-F778E(AU) may also be set up for simulcast recording, audio dubbing and mixing two soundtracks together for Sound-on-Sound.

The front-loading Hitachi VHS Video Deck Model VT-F778E(AU) measures 435 (W) x 92 (H) x 338 (D) millimetres. A second Euro-connector is provided for easy interfacing with compatible stereo TV sets.

Recommended retail price of the VT-F778E(AU) is $999 and the set carries a 12-month warranty on all parts and labor, including the heads. Further information is available from Hitachi Sales Australia, 153 Keys Road, Moorabbin 3189; phone (03) 555 8722. ■

The ABC develops new system:

'Tape-less' radio broadcasting

It has been practical for some time to store quite significant amounts of high-quality audio programme material in digital form on magnetic hard disks. But until very recently, the costs of providing adequate storage capacity tended to prevent such systems from being used for day-to-day radio broadcasting. In any case, systems for convenient user access and control were still being developed. Australia's own ABC has now developed a new system, which is in the process of being placed into service at the Corporation's new Ultimo facilities.

by TERRY KEE

Digital audio technology has stamped its authority on consumers in the form of CD and DAT, and is almost taken for granted these days. Digital technology for radio broadcasters and other professional users has similarly not taken a back seat. Digital audio recording systems based on hard disk technology have been appearing in the market place, in applications for audio post-production work in film and television.

The advances made in computer hard disk technology have made possible the large amount of data storage needed for high quality audio, at costs comparable to the high end of the analog market.

Some time ago the ABC investigated the use of this technology to provide a digital audio storage, retrieval and editing system to satisfy the specific needs of radio broadcasters. They discovered that a suitable system was not yet commercially available. However the ABC had gained experience in designing its own hard-disk based digital audio time-zone delay system, for its radio national networks. Armed with this technical expertise, work commenced about two and a half years ago on the design of a system called 'Digital Cart' (D-Cart) by the ABC's Design and Development Department.

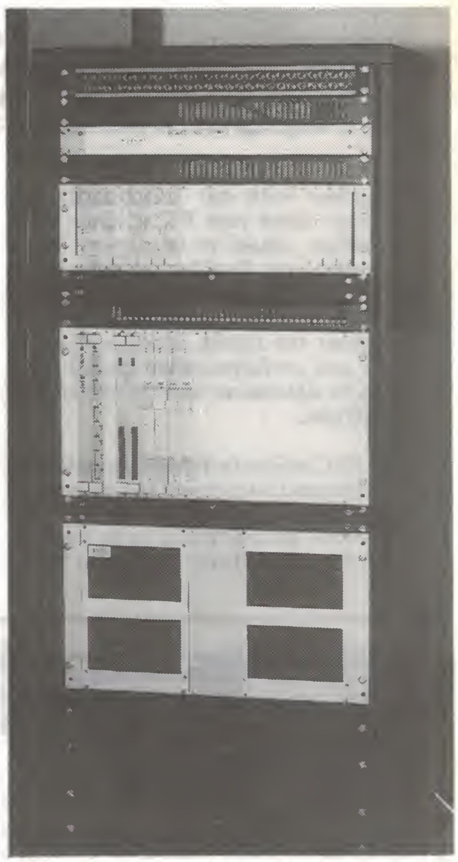
D-Cart in radio

The application of D-Cart in radio broadcasting is to replace analog tape and cartridge machines, and to provide comprehensive operational and editing facilities.

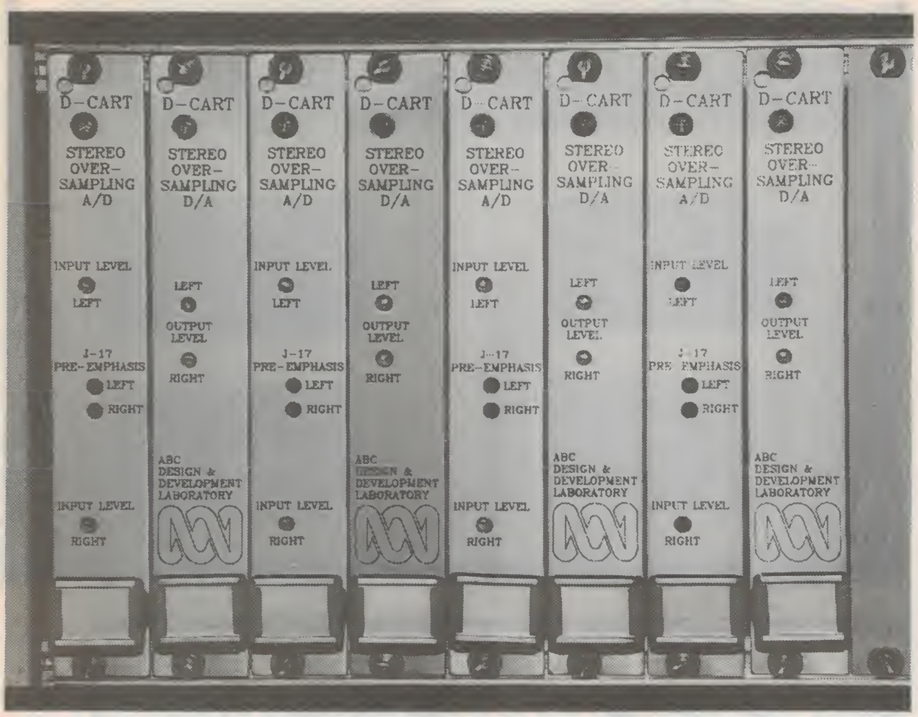
The most common recording media in radio is 1/4" magnetic tape, which is used in open reel and cartridge machines. Although the tape media is very cost effective, the maintenance of the tape machines with their many precision moving parts tends to be expensive and labour intensive. The number of tape machines in an organisation like the ABC tends to run into several hundreds. If you've wandered along the corridors of the ABC studios, you will probably come across a tape recorder or two in almost every room. In addition the editing of tape is tedious and time consuming, and the audio life expectancy of magnetic tape for archival purposes is limited.

One of the most important advantages of D-Cart in a radio environment is the accessibility of the system to multiple users. Up to 24 users can access the system simultaneously. This feature provides enormous benefit to the running of a radio station, as programme material residing in the system can be accessed by different users virtually at the same time without requiring any tape duplication. Stored programme material can be found very quickly using computer data search techniques and it can be cued up, played or recorded in an instant. The editing of the material is simple, fast and non-destructive, which is advantageous as only the edit points of a recording need to be determined and the original material remains intact.

Security is another important factor that is high on the agenda of radio broadcasters. D-Cart supports this issue fully, by using ID procedures as found in multi-user computer systems. Permission to access legally sensitive and inappropriate programme material stored in the system or specific opera-



The D-Cart system hardward. Note the installation of four 1.2GB Winchester disk drives in the rack.



The D-Cart system's A-D and D-A interface modules.

tions can be restricted by the system manager. This feature provides a mechanism to ensure that any unauthorised material cannot accidentally be put to air.

D-Cart hardware

The hardware for the ABC's D-Cart system is housed in a standard 19" rack system and can be split into three subsystems: the digital audio interface, digital signal processing/control and the disk storage device.

D-Cart uses 1.2GB Winchester hard disk drives as the storage medium. The system deals with any computer or hardware failure by having redundancy built into the system. 'Mirror' drives are used, where the disk drives and associated computer control are fully duplicated to cope with any component failure.

Further system reliability is achieved by dividing the system into two completely separate sub-systems, each of which supports half of the end users. In the event of one system failing, then the other half takes over. This ensures that programme can still be put to air in spite of a system failure.

A pilot D-Cart system was installed at ABC-FM (91.7MHz) on the Gold Coast, about 16 months ago and has been operating successfully without any problems except for some software bugs in the interface.

Software debugging was accomplished in Sydney using modems, and highlights an important advantage of using D-Cart in a national network. The reliability of D-Cart was proven quite conclusively, as the pilot system was operating without any built-in redundancy.

Optical read/write disk drives are currently being evaluated as a secondary storage medium. The optical disk storage capacity of 600MB and slower access time of 26ms makes it less appealing than Winchester drives, but the main advantage is the portability of the disks. Optical disk and R-DAT are seen to be the storage media for archiving programmes.

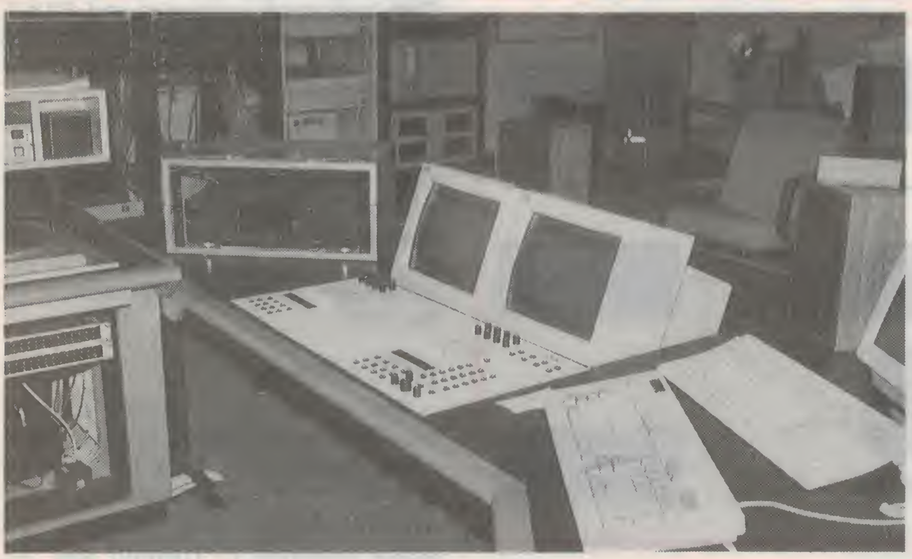
The audio input is encoded using 16-bit ADC's, with 64 times oversampling. The sampling frequencies are 32kHz, 44.1kHz and 48kHz and are switched under software control. Two audio channels are contained on a single module. The balanced inputs have an input impedance of 30k ohms and the clip level of the converters are 19dBu.

At the other end of the system, the output DAC modules also have two channels on a single module with 16-bit resolution, 40 ohms output impedance and a 19dBu clip level. The converters are available in a modular form, as each D-Cart system will be custom built to suit the user's specifications; the appropriate number of ADC and DAC modules will be installed to suit.

Audio inputs/outputs allow up to typically 34 record/replay channels to be used simultaneously. Analog audio outputs are available now, but digital outputs adhering to AES/EBU formats will be available by the middle of this year.

The system's recording capacity depends on the number of disk drives and controllers supporting it. The open architecture of D-Cart allows the end users to specify their requirements, with the option of increasing the recording capacity at a later date.

A single 1.2GB disk drive can typically store two hours of stereo programme at the 32kHz sampling rate.The data is recorded on the disk in a linear form without any compression, to obtain the highest possible audio quality. This requirement was specified at the onset of the development of D-Cart.



A 'Ouija' touch-screen VDT on-air console at 2JJJ's training centre in ABC House.

The response to execute replay and edit commands takes less than 50ms, while all other commands take less than 250ms. Screen display of disk directory listings etc., occurs in less than two seconds.

User interfaces

The methods provided for users to access and manipulate the stored audio are a very important consideration, and one of the most critical uses is on-air control. The D-Cart system is accessed by touch-screen video display terminals (VDT's) for on-air broadcasting.

The ABC is using a touch-screen VDT system developed by Paul Kirk Electronics (PKE) based in Perth. The touch screen on-air console is an ABC modified version of the PKE 'OUIJA' 3TT system.

It is based on two VDT screens, the schedule and the support screen, along with a consolette. The schedule screen displays items of the schedule to be put to air. The touch function allows the items of the schedule to be cued up or to be deleted etc.

Other operational controls such as bar-graph ppms (peak programme meters), audio channel assignments and standard mixer settings are also displayed.

The support screen displays file information such as CD selection control and D-Cart file data. Using two video screens allows important on-air information to be always clearly displayed, without requiring any of the text to be overlayed.

An ABC addition to the OUIJA system is a consolette which has an eight-channel audio mixer. The use of a mixing capability with conventional faders is to overcome the touch screen's inability to recognise more than one touch function at one time. Hence a simple function such as a cross-fade between two channels would be virtually impossible to implement.

In addition to the VDT there are machine control interfaces, which allow D-Cart to be remotely controlled by other studio equipment such as broadcast consoles.

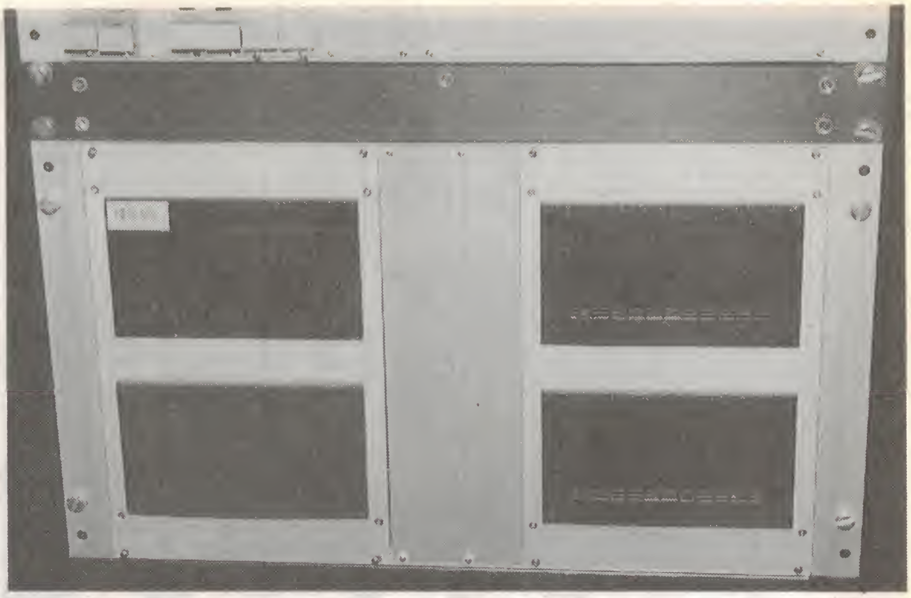
The system uses RS-423 and RS-422 25 pin D-type interfaces for these applications. A conventional keyboard station is also used to maintain the administrative work such as file development and configuration, creating and editing schedules and system management.

Printing hardcopy is available through Centronics or serial interfaces. Editing facilities are available on a VDT editing console which is similar to the on-air console, but fitted with a 'jog wheel' to shuttle audio backwards and forwards to determine the precise edit points.

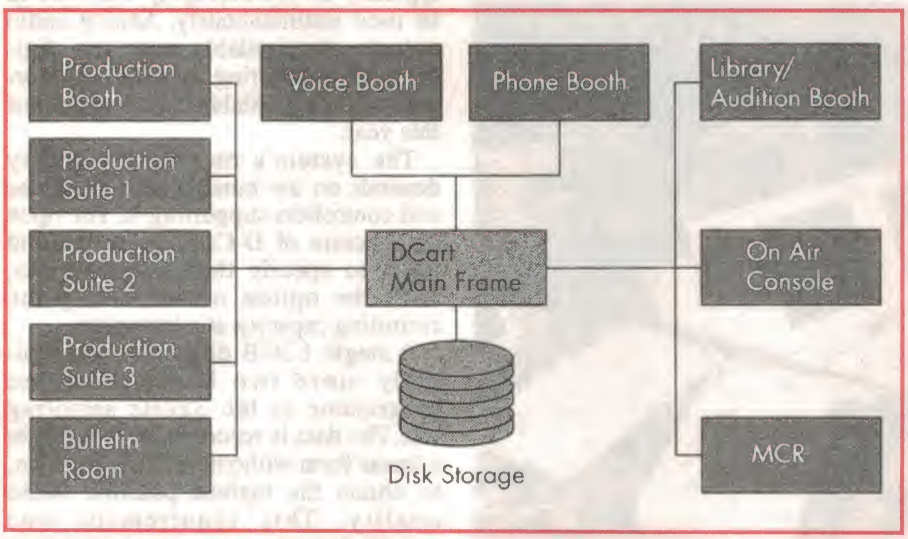
The audible search time to locate an item of programme is two or four times the normal speed, while the jogging speed ranges between 0 and 100% of normal speed.

The touch screen VDT on-air consoles can also be interfaced to other computer systems such as the network switching computer, Vax computer, D-Cart, newsroom computer and PABX telephone system. Work is currently being done to have all these facilities linked together.

An Ethernet interface provides connection to a range of devices such as text management computers and printers. Ethernet provides data networking to other D-Cart systems, so that their databases can be accessed across the national network of the ABC.



A close up of the four 1.2GB Winchester drives in 2JJJ's D-Cart system.



The basic architecture of the ABC's D-Cart system.

ABC Ultimo

The ABC's Ultimo project was undertaken to centralise all the ABC radio facilities in one location in Sydney's inner-city Ultimo.

Three complete D-Cart systems are being installed in Ultimo, and the facilities are to be shared in clusters

within the networks of ABC Radio. News and Sport are sharing one D-CART system, 2BL and Radio National are sharing another, while 2JJJ has the third system.

Each D-Cart system being installed in Ultimo has twelve 1.2GB disk drives. The 2JJJ cluster is configured to have 10 stereo record and 16 replay audio channels, while the 2BL/Radio National cluster has 11 stereo record and 13 replay channels.

News and Sport are allocated 23 multi-user terminals, of which three terminals will be on-air touch screen OUIJA systems. Radio National/2BL will have eight multi-user terminals with three OUIJA on-air consoles, while 2JJJ will have 13 terminals with two on-air consoles.

D-Cart is expected to make major changes to operations in Ultimo. News is envisaged to be completely 'tape-less', with the journalists doing their own editing as the task now becomes so simple. Electronic news and text systems are integrated with D-Cart so that the journalists can link them easily in a news bulletin. Audio items could also be inserted by the news reader as he puts the bulletin to air.

A news item could be retrieved from the database, edited quickly, its time duration checked, approved by the news chief sub-editor and then put to air without having to dub to magnetic tape at any stage.

The installation of the three D-Cart systems in Ultimo was scheduled to be completed in January 1991. Radio National/2BL's cluster was to be operational in March, and the two other systems in April.

The ABC is currently marketing its D-Cart system to other radio broadcasters on a commercial basis. Each system will be customised by the ABC to satisfy individual station requirements. The flexibility of D-Cart's system design allows users to start with a simple record and replay device and end with a sophisticated editing system, by adding to the initial purchase.

The technology to operate a radio station in a tape-less environment is now a definite reality, with the availability of D-Cart.

The transition to this new exciting digital era is likely to be further accelerated with direct digital radio broadcasting, now on the horizon.

In closing, I would like to thank Spencer Lieng, Head of the ABC's Design and Development Department, for supplying the information on D-Cart. ■

FORUM

Conducted by Jim Rowe

A reader takes me to task over my January 'MAC' editorial

My editorial in the January issue commenting on the merger of Murdoch's Sky Television and its competitor British Satellite Broadcasting has very definitely *not* met with the agreement of one reader. He has taken special exception to my lament for the apparent dropping of the MAC/EuroCypher transmission system, which he suggests has very few advantages in practice — given the current systems and equipment in use...

It was about time we had a break from fancy audio cables and earth-leakage circuit breakers, as I'm sure you'll agree. I had planned to introduce a new topic this month in any case, as well as perhaps devoting a bit of space to some of the letters that have turned up in response to my piece in January's Forum on AM and sidebands. However another letter arrived not long after the January issue was published, responding not to the Forum piece but to my editorial about the Sky Television/BSB merger and its likely effect on satellite TV/HDTV transmission standards.

The letter came from Mr Keith Walters of Lane Cove, NSW, and judging from the depth of feeling expressed in its 5-1/2 closely typed pages, Mr Walters obviously believes that I was 'talking through my hat'.

Well, perhaps he's right. I certainly don't claim to be an expert on satellite TV transmission — or on anything else, for that matter. Quite the reverse: I'm essentially just a 'GP' in the electronics field, really, with a good basic training and a little applied knowledge in a lot of different areas.

That generally means that when I stick my neck out and comment in the magazine about specific details, there's always the risk that I can be proved wrong by someone with a lot more knowledge than I have in the field concerned. Them's the risks, I guess...

Still, I'm jumping the gun. Let's give Mr Walters the chance to make his points, before attempting to make any apologies or explanations.

Before we do so, though, I should perhaps explain a couple of the terms he uses — for the benefit of those who aren't familiar with them. A *composite* video signal is a conventional one where the luminance (brightness variations), chrominance (colour) and synchronising information are all combined into a single encoded signal — like the PAL signal produced by a standard domestic video camera or a VCR (from its 'video' connector).

Traditionally such composite video signals have also been used by TV stations, for most of their video signal switching, mixing, processing and manipulation. The composite PAL signals are produced by combining the luminance, chrominance and sync information from each camera, VTR and film/still scanner, and manipulated as such in the bulk of the station's equipment. Then the final 'to air' video signal is split back into its separate components, before feeding to the vision transmitter's modulator.

More recently, however, there has been a move for TV stations to keep the video in its original separate *component* form and manipulate it in this form, rather than combine it into composite signals. Although this makes everything rather more unweildy, it is also said to offer the potential advantage of better quality pictures — due to fewer video transformations.

Hopefully that gives you at least a basic understanding of the distinction between 'composite' and 'component' video. Now over to Mr Walters:

For your information, MAC transmission is far from being a panacea for all the ills (real and imaginary) besetting the television industry at the moment. MAC (multiplexed analog component) transmission is only one small link in the very long chain known as 'component video'.

True component operation requires that the luminance and the two colour difference signals are kept separated through stages of the production, transmission and reception process — eventually supplying (through MAC transmission) separate luminance, B-Y and R-Y signals to the TV receiver.

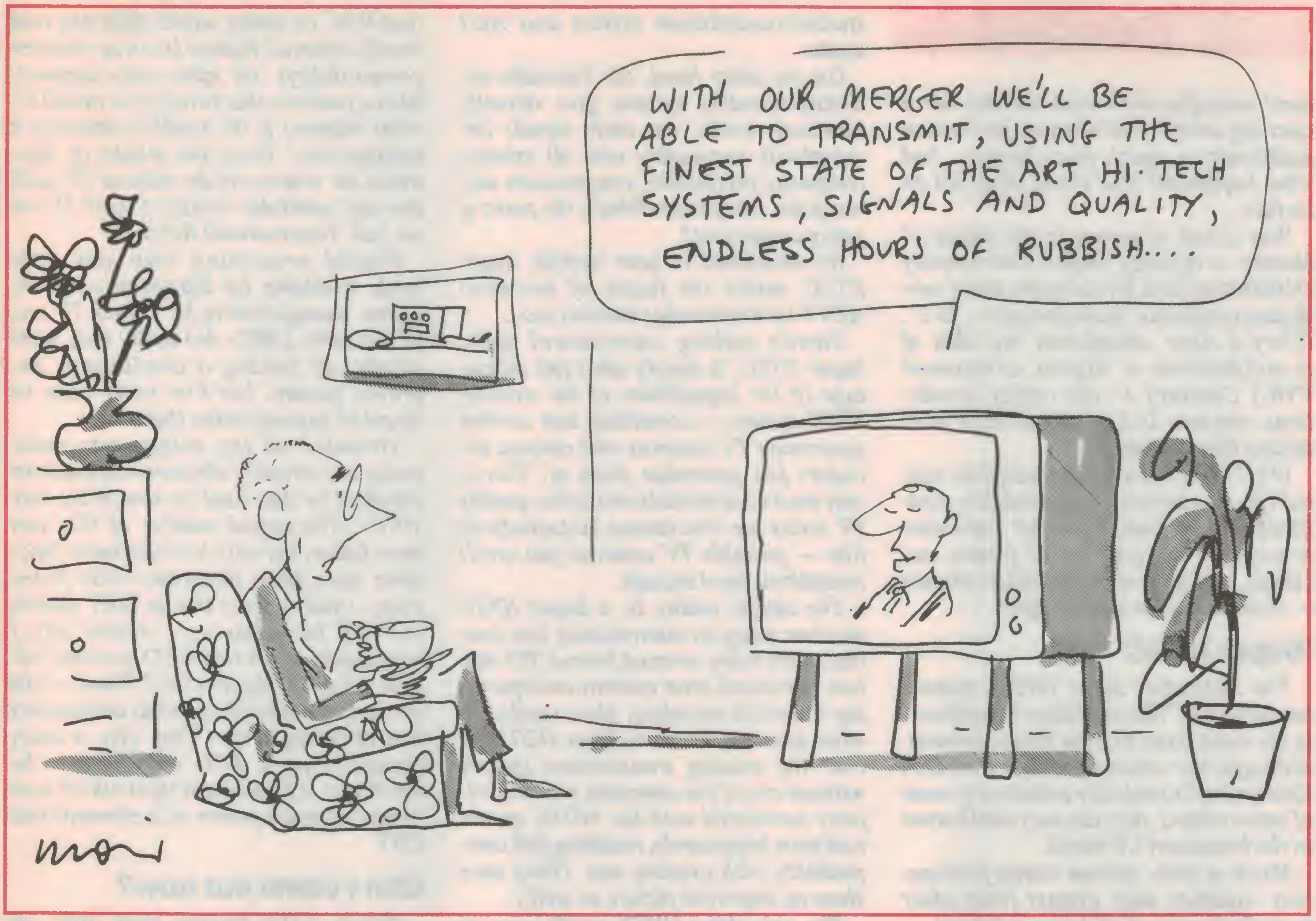
Now, there is no argument that this would provide the best possible picture quality. But if at any stage of the production process the signal has to be converted to standard composite video (i.e., the colour difference signals are modulated onto a colour subcarrier and mixed with the luminance) and then subsequently re-converted to component form, most of the benefits of component operation are completely negated.

There is simply no known process whereby composite video from currently used sources (see later) can be converted back into components indistinguishable from the originals. There is ALWAYS some degradation. This is particularly so if the final component signal has to be re-converted to composite video for broadcast.

Certainly, if TV was only starting up now, yes, we'd almost certainly build all-component studios and use something like the MAC system for broadcast. Composite studios as we know them would probably never have existed. A few European TV networks recently started from scratch and have in fact adopted this approach.

But we aren't just starting up now — there are billions of dollars worth of colour TV equipment out there already which, all-in-all, is doing a pretty good job.

Yes, all-component operation might do it a bit better, but not nearly 'better enough' to be worth spending megabucks on — extravagant claims by component equipment manufacturers



notwithstanding! Trying to adopt an 'evolutionary' approach (i.e., introducing component systems on a piecemeal basis) would mean significant picture degradation until such time as the process was complete. If you want an example, this is EXACTLY what happens to the SBS transmissions! (Have you ever noticed how 'soft' the pictures are?)

With our present broadcasting stations, simply converting to MAC for transmission would simply yield inferior pictures, to no discernable benefit.

Chaos in Europe?

What 'existing chaos' in Europe? There are only two video standards in Europe — PAL and SECAM. The adoption of SECAM by the French was an incredibly short-sighted move, but that's their problem. I could write pages of things that are wrong with the System Engineered by a Committee of AMphibians, but its major drawback is that, because SECAM uses an FM colour subcarrier, you can't fade to black, mix, wipe or use virtually any of the other production effects possible with PAL or NTSC; at least not without severely crippling the luminance bandwidth.

So how to they cope? Simple — most of the studios do all their work in PAL, transcoding to SECAM for transmission! (The same applies in what used to be the Communist Bloc.) So most material sourced from France is PAL anyway.

Certainly in SECAM countries, all-component operation would be a considerable improvement, and the French are understandably enthusiastic about the idea. Unfortunately, the rest of the PAL world has demurred somewhat at the prospect — getting the French out of the corner they've painted themselves into does not seem high on the list of priorities. Better that they should convert to PAL!

Incidentally, it was NOT 'Europe's technical experts' who developed MAC — it was developed by Scientific Atlanta in the USA. And if the cost of and restrictions on licensing agreements are anything to go by, it was done for only one reason — to make money for the designers. There's nothing particularly brilliant or innovative about the idea — a well-engineered system, certainly, but I would have to say the NTSC system was far more ingenious!

And on that subject, MAC systems offer little help with what many people erroneously think is the major problem besetting broadcasters: PAL/NTSC conversion. In fact, for composite NTSC (or PAL) supplied on videotape, modern standards converters do a really excellent job. (This does not apply to the clapped-out 15- year-old DICE converters still used by some Australian TV stations!)

Surprisingly, the only real problem occurs with live satellite links, the problem being the 59.94Hz NTSC field frequency vs. the 50Hz for PAL. Life would be so much easier for standards converter designers if NTSC used exactly 60Hz! (With taped material, the playback machine can be speeded up slightly, but you can't do that with a satellite feed!) The reasons behind all this are too complex to go into here — the point is that using MAC transmission is of no help in solving this particular problem.

A few years ago, the video industry journals were bristling with gung-ho articles (and manufacturers' ads) about the coming dominance of component television equipment. The '4:2:2' digital component standard was going to be the dominant format, and so was Matsushita's 'MII' analog component format — and so, apparently, was Sony's SP Betacam format. Ancilliary equip-

ment manufacturers were turning out a dazzling array of component production equipment to match these formats. And what happened? The whole thing fell on its face.

Was it lack of money in the industry? Hardly — recently Ampex were roundly criticised at first for bringing out a new digital composite video format — 'D-2'. (They'd since abandoned the idea of manufacturing a digital component VTR.) Contrary to the critics' predictions, the new D-2 machines have been selling like hot cakes!

Why? Well, because they could be slotted into an existing system with few modifications, were much smaller and easier to use than the existing 'C' format machines, and gave a visibly better picture — actual tangible advantages!

'Super NTSC'

The Faroudja 'Super NTSC' systems mentioned in 'Silicon Valley Newsletter' in the same issue deserve some comment. Although the name Faroudja Research Enterprises is probably unknown to most of your readers, they are very well known in the broadcast TV world.

Much of their income comes from patent royalties they extract from other manufacturers of video equipment — particularly the Japanese! For example they hold key patents for the chroma/luminance separation systems which are an essential part of the domestic Super VHS and other enhanced formats.

Their 'Super NTSC' system employs a number of strategies in the video encoding process which, when it is re-processed through a complementary decoder, almost perfectly re-create the original full bandwidth RGB signals from the camera — something that was considered impossible only a few years ago. (An analogous system is available for PAL, although they haven't been actively marketing it as yet.)

Ironically, Super NTSC was originally seen as an answer to the problems of introducing component systems into the composite environment. Its ability to convert flawlessly composite video back to its original components was seemingly just what the industry needed.

Or was it? Someone seems to have lost track of the plot! The whole idea of all-component operation was that it enabled the delivery of perfect full-bandwidth components to the receiver. The only (!) drawback was that, to achieve true all-component operation, you had to bulldoze virtually the entire studio/transmission system and start again.

On the other hand, the Faroudja encoding/decoding systems give virtually identical results, but their signals are completely compatible with all existing composite production, transmission and reception equipment. What's the point of going component?

As mentioned in your article, Super NTSC makes the future of so-called HDTV look somewhat dubious too...

There's nothing supernatural about Super NTSC; it simply takes full advantage of the capabilities of the existing NTSC system — something that current generation TV cameras and chroma encoders fall somewhat short of. This is why most commercials and better quality TV series are shot almost exclusively on film — portable TV cameras just aren't considered good enough.

The simple reality is, a Super NTSC receiver using an interpolating line doubler, with video sourced from a 525-line non interlaced scan camera incorporating Faroudja encoding, gives results almost identical to those from HDTV — over the existing transmission system, without any of the annoying motion artifacts associated with the MUSE system and most importantly, retaining full compatibility with existing sets. (They even show an improved picture as well.)

The only thing HDTV would seem to have going for it is its 16:9 aspect ratio, and I can't see broadcasters spending billions of dollars just for that. In any event, if it was really that important, changing the aspect ratio of the present systems could be done much more easily for far less cost.

Even with completely unmodified existing transmissions, Super NTSC receivers yield a considerable improvement in picture quality. This is a sore point with many critics of HDTV (like myself): comparisons of picture quality can surely only be legitimately made between HDTV on a MUSE receiver and something like Super NTSC on a Super NTSC receiver.

But what we usually see are HDTV from a digital VTR, compared with standard NTSC on a standard NTSC receiver — or even worse, the HDTV signal in a down-converted form. This is nothing less than misleading advertising, as far as I'm concerned.

Having said all that, I very much doubt that our transmission standards are going to change much in the next couple of decades, anyway. While I agree that in theory at least, satellite distribution would be by far the best method of terrestrial broadcasting, I do not believe that MAC encoding would offer any real benefit when all factors (such as receiver compatibility) are taken into account. Also a problem that rarely gets raised is: what happens if the satellite develops a malfunction? Does the whole of Australia (or wherever) do without TV until the next available Shuttle flight? Or do we call 'International Rescue'?

Digital processing chip sets were made available by European semiconductor manufacturers for colour TV sets in the early 1980's. No doubt they were capable of yielding a considerably improved picture, but I've never seen or heard of any sets using them.

Virtually all the colour sets made today use circuitry electronically almost identical to that used in sets in the late 1970's. The actual number of ICs may have fallen, but only because more functions have been integrated onto fewer chips. I fully expect that in 2001 people will still be buying very similar sets. I very much doubt that LCD screens will ever get much bigger than 150mm — the present manufacturing yields are already heartbreakingly low. They give a lousy picture anyway, AND they have to be backlit by a fluorescent light which uses almost as much power as a conventional CRT.

Can I come out now?

Phew! After having that little lot dumped on me, I feel as if I've just been subjected to the written equivalent of B-52 carpet bombing. I certainly hope writing and sending it off made Mr Walters feel better...

Seriously, though, Mr Walters does make quite a few very interesting and worthwhile points. For example I take his point that we shouldn't automatically assume MAC systems provide sufficiently improved performance to justify scrapping existing systems, in which there is obviously a huge investment.

I suppose I hadn't realised that a MAC transmission system presupposes input signals in component form, although it certainly makes sense now that Mr Walters has pointed it out. I also hadn't realised that there can be a serious degradation in picture quality when composite video signals are converted back into component form. I imagine this does cause problems in implementing a 'stage by stage' changeover from a composite system to a component system, and would tend to detract from the received picture quality during this kind of a gradual system upgrade. Transmission quality would presumably get worse before it got better, in other words...

The funny thing is that in the editorial

Yves Faroudja —Making NTSC better and better...

As a boy growing up in Paris, Yves Faroudja became fascinated with the miracle of television. This early interest blossomed into a career as an electronics engineer, eventually taking him to Sunnyvale in California's Silicon Valley.

For the last 20 years or so Faroudja has worked on ways to improve TV signals and the performance of video monitors. Among his 17 patents are several covering techniques to clean up NTSC images and reduce interference between the luminance and chrominance components. Some of his patents are used by JVC and Sony in the latest camcorders and VCRs.

His latest proposal to America's FCC is 'Super NTSC', a system of enhancing standard NTSC transmissions that is claimed to provide most of the benefits of high-definition TV, without the latter's cost and compatibility problems.

concerned, I wasn't really seeking to promote MAC transmission as such. I was mainly trying to suggest that while technical people like ourselves generally strive to achieve the highest performance that can be produced using known technology, and also place a high value on technical standardisation, often *neither* of these considerations is a high priority when real-world business decisions are being made.

In reality I'm not all that enthusiastic about any of the MAC systems as such, either. Like Mr Walters I've gained the impression that received picture quality was not necessarily a major factor behind their development. I suspect that the motive of 'commercial advantage' *was* fairly strong, although it may be a good question to ask *whose* advantage.

My impression is that much of the impetus behind the development of MAC systems is the trend away from traditional TV and radio broadcasting that is 'free' to the viewer/listener, and towards restricted narrowcasting and pay-TV/radio services. The big advantage of MAC systems is that they are very effectively 'secure', allowing easy control over who can receive the signals and who can't. So reception can be restricted to only those people that the authorities and/or program providers wish to have receiving it — for whatever reason.

As well as bumping up the cost of a receiving setup, MAC systems are therefore ideal for allowing broadcasting authorities to exert control over broadcasting. They also allow the protection of industry interests, by restricting the viewing choices of viewers in each area. And of course they're ideal for delivering pay-TV services, as the ability of each and every viewer to receive signals can be controlled individually and continuously from the transmitting end. Forget to pay your bill, and suddenly your MAC receiving setup becomes inoperative; pay up, and it springs back to life!

I don't think there's any doubt that it was this kind of consideration that resulted in the B-MAC system being chosen for Australia's satellite TV broadcasting via HACBSS, etc. It wasn't because the system offered dramatically better reception — or for that matter, to contribute to the profitability of Scientific Atlanta.

My guess is that neither the authorities nor the commercial broadcasters and networks wanted viewers to be able to receive signals freely. They probably feared that this would lead to an 'open slather' system, a bit like that which has developed in the USA, where virtually anyone can set up and dish and downconverter, and simple decoders are freely available at low cost to crack the encryption used by pay-TV broadcasters.

Perhaps they're right; perhaps we do need to ensure that things don't get out of hand, so that commercial broadcasters can't get a reasonable return on their investment. And I don't doubt that there will be a role for pay-TV and other kinds of narrowcasting service in the future, supplementing traditional broadcasting.

All the same, I must confess that the kind of centralised control which can be achieved using MAC systems for broadcasting does leave me with an uneasy feeling. It all sounds a bit Orwellian, somehow, with 'Big Brother' able to exert such a tight control over what any of us can even receive and watch on our TV set.

Part of me can't help admiring the 'cowboy' attitude in the USA, where everyone assumes the right to receive any signal propagated over the air waves, and if necessary to 'crack' any encyphering which the originator has used to try stopping them.

Anyway, Mr Walters, I'm not really a convinced supporter of MAC systems, whatever you may have thought — far from it.

Mind you, the idea of using MAC systems for satellite TV did seem to offer the possibility of achieving a new technical broadcasting standard, open-ended enough to keep open everyone's options when it comes to HDTV. But on the other hand, there has always been a suggestion that another major and 'hidden' motive behind the development of MAC systems was the idea that they would provide both the USA and European TV industries with a way to 'lock out the Japanese'. This scarcely seems a recipe for establising a new global standard...

Specific points

Now for some of the specific points raised by Mr Walters, and which seem to need at least brief comments.

There's no 'chaos' in Europe's TV broadcasting, he says, because there's really only two systems — and one's crazy, so we don't need to worry about it.

Sorry, but I don't think that's realistic. Even within the countries using 625-line PAL, my understanding is that there are some using a 5.5MHz sound subcarrier, some with 6MHz and some with 6.5MHz. Then in the 625-line SECAM camp there's France and Monaco with positive luminance modulation and AM sound on a 6.6MHz subcarrier, while other countries combine the 625-line SECAM with normal negative luminance modulation and 6.5MHz FM sound. Not to mention the NTSC transmissions in cities where there are US military bases, plus the variety of different satellite TV encryption systems is use already.

That kind of a selection mightn't sound like chaos to you, perhaps, but I think it'll do me until something worse comes along!

I take Mr Walter's point that the basic MAC system was originally developed in the US by Scientific-Atlanta. However my impression is that the Europeans have played a key role in the development of the later 'enhanced' MAC sys-

tems, like D-MAC and HD-MAC. That's why I used the term 'Europe's technical experts', as it was these later variants I had in mind.

As for whether MAC is more or less 'ingenious' than NTSC or PAL, I think that's a fairly subjective decision. At the time it was developed, the NTSC system was undeniably an ingenious way of 'squeezing' colour information into the existing monochrome TV signals, and in a way that caused relatively minimal picture degradation.

On the other hand, the MAC system seems also fairly ingenious from a technical point of view — particularly its method of encryption. Just how you could decide which was the more ingenious, I don't know. But then, I don't know why you'd want to, anyway.

Mr Walters' criticism of the demonstrations used to compare HDTV systems with various alternatives also leaves me a bit bemused — especially as I hadn't made *any* specific comparisons of this kind in my original editorial.

It seems to me that the legitimacy of a comparison depends upon whatever it is that you're seeking to demonstrate or investigate, surely.

In this case if you're seeking to show that a particular form of HDTV gives a significant improvement in picture quality or visual impact, or whatever, compared with existing 'plain vanilla' PAL or NTSC, then surely you'd do this by demonstrating it against a standard PAL or NTSC receiver playing standard signals. On the other hand if you wanted to show that a particular HDTV system was highly compatible with the existing system, you'd have a demonstration comparing the pictures produced by an HDTV set and a standard set, with both playing the same 'compatible' HDTV signals.

Of course if you wanted to compare the relative reception quality produced by a particular HDTV system with a particular 'enhanced standard system' like Super NTSC, then the most valid comparison would be between an HDTV receiver playing its appropriate HDTV signals, and a Super NTSC set playing its appropriate Super NTSC signals.

It seems to me the important criteria are (a) whether or not the things being compared are what they're claimed to be, and (b) whether or not these things are valid measures of the claims being put forward. Providing these criteria are met, then I'd regard a comparison as valid. Wouldn't you?

So when Mr Walters says that we should only be comparing HDTV on a MUSE receiver with Super NTSC on a Super NTSC receiver, I'm not at all sure what he's driving at. Does he mean that these two systems are the only two possibilities for the future, and that therefore all we have to do is choose the better one?

As I understand it the Japanese MUSE system is only one of many that have been proposed for HDTV transmission, while the Super NTSC system is one of a number of proposed systems for 'enhancing' existing standard TV systems. Selecting just these two for comparison seems rather arbitrary; especially as neither seems of much relevance in terms of Australia's own television future. If we were to go the 'enhancement' route we'd presumably go to something like Super PAL, while if we were to go HDTV we'd probably want to look seriously at HD-MAC rather than MUSE.

Personally, I'd like to see a comparison between standard Australian PAL, Super PAL and say HD-MAC, all playing off-air signals originating from the same programme source. I feel sure that such a comparison would not only be valid, but both relevant and worthwhile as well.

Finally, I note Mr Walters' comments about digital signal processing chip sets for TV receivers. He may not have seen or heard of any sets using them, but my understanding is that at least some of the latest Philips models use them. An example is the 28DC 2070, which we reviewed back in the May 1990 issue.

It isn't all that surprising that Philips would be using these chips in its sets, being a major European player in both chip and set manufacture. However I suspect that other European brands such as Blaupunkt and Telefunken are probably also using them, even though they haven't made a lot of noise about it.

Actually even if the latest sets from Japan and Korea aren't using these same chips, I suspect they're using ones with similar capabilities, judging by the features and facilities being offered.

I think those are the main comments I'd like to make about Mr Walters' missive. But what do other readers think, about either the points he's raised, or the general subjects of the future of TV broadcasting, satellite TV, pay-TV, MAC and HDTV?

They're interesting subjects, and ones that seem very relevant regarding Australia's options in the near future. So please feel free to weigh in with your 43 cents' worth, too. ■

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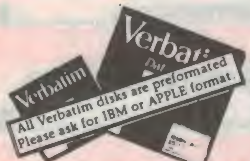

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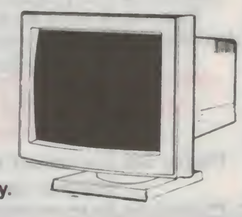

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ELECTRIC CURRENT FLOW DIRECTION SOLVED AT LAST

The following report is reprinted from a little-known French publication called *L'Electronique*. The article was first brought to our attention by a staff member from the University of Applied Sciences, Jasmine, WA. It has been translated by Mr Pierre d'Indy, and as you will see it contains some remarkable findings. We have edited the article to reduce its length, as it contained a lot of complex mathematics and scientific jargon. Read on and see what you think.

by P. DE TANTE, A. LA CROIX and R. CHEVAUX

In presenting these findings, it is important to stress that the experiments that have led us to our conclusions are repeatable. It is our intention to conduct these same experiments at the *European Scientific Forum* to be held in August 1991, which will show that some of the previously held beliefs about atomic theory are incorrect. Before describing our findings we wish to first provide details of the experiments we have conducted.

In May, 1989 during our experiments concerning the acceleration of toidis *(a subatomic particle — Ed.)*, a small magnetic field was measured. As a toidi has no inherent electric charge, this presented a mathematical impossibility. *(Mathematical proof included, but not reprinted — Ed.)*.

Our experiments continued, but this time using a quantrium deflector connected to a Schlapphurst field generator. This technique gave improved toidi discharge with greater intensity at the focal point.

Again we measured a magnetic field of 10pW (pico webers). We could not explain the magnetic field and we decided to repeat our experiments at Froume, some 100km from Lyons where the original experiments had been conducted. The same results occurred.

These results convinced us that the structure of an atom differs from the popular Bohr model and we decided to request a grant from the French Government to conduct further experiments. This was denied, but support was offered by the Universitie de Grounne where the remainder of our experiments were conducted.

(There now follows a detailed description of the experiments with pages of mathematics that allegedly confirm their validity — Ed.)

From the above, we are left with no alternative but to offer the following conclusions: *(There are some 23 conclusions, and we reprint here only a few of the more significant ones — Ed.)*.

The first and most important finding is that the popular belief that an electric current is a flow of electrons is incorrect. Our experiments included isolating a toidi quanta packet and observing its effect on a frog. The twitching effect was statistically significant.

Our findings suggest that an electric current comprises a complex movement of interactive, phase aligned 'glued' carriers (IPACs). The toidi is the 'glue' for the carrier, and the charge contained in these carriers is the effect of the energy level interchange between each active toidi transfer.

We also conclude that the direction of flow of an electric current is from positive to negative. We have confirmed that while electron flow does occur, this is a reaction rather than the cause. The energy transfer is sustained by the flow of IPAC carriers, which flow in the opposite direction to the electron flow.

We conducted experiments that ensured the absence of toidi collaborators and confirmed that the frog remained still. However, there was a noticeable burning effect that suggested energy, but without charge.

The reason this has not been observed before is that contemporary measuring equipment has hitherto been unable to differentiate between IPAC flow and electron, flow as electrons are much larger than a toidi cluster.

The popular belief that a voltage is a function of dissimilar numbers of electrons between two points is therefore erroneous, as again this is an effect and not a cause.

(There are other conclusions, but the last paragraph of this report is perhaps the most significant of all — Ed.)

The contemporary belief that an electric current is the result of the separation of electron charges is false. Our experiments have shown that by isolating IPAC quanta, considerable energy at high voltages can be produced. To achieve this, a toidi reaction cell is required, and preliminary experiments suggest this can be achieved by passing marsh gas at very high speeds through a Wollings coil. This coil comprises 650 turns of 36mm diameter pipe made of Grunnherder metal. *(No details supplied on this type of material — Ed)*.

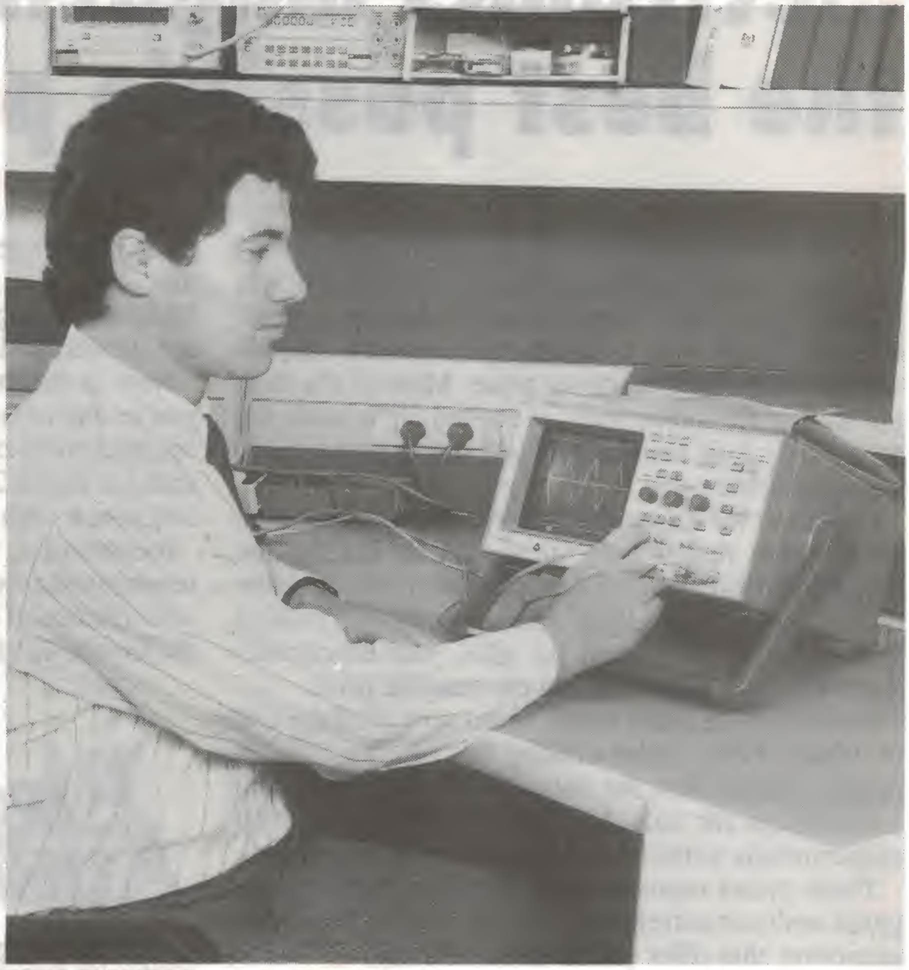
The potential developed causes a self sustaining reaction, and the energy output is controlled by mixing vatrium vapour with the marsh gas. Because the marsh gas is confined in a cyclical system, there is no pollution except the occasional discharge of unwanted electrons. The effect is 'heavy air' which needs to be filtered before discharge into the atmosphere.

Editor's Note: We have a photocopy of the original article which we believe to be genuine. A member of our staff who has a smattering of French has been unable to deny the validity of the translation, although much of the scientific proof is numerical and therefore stands on its merits. Unfortunately it is too complex for us to fully understand.

We'll leave it to you to figure out the consequences of all this, as they are quite profound. But we just wish the scientific world could make up its mind as to what the direction of an electric current really is. And where did they get the name 'toidi' from? ■

NEWS HIGHLIGHTS

HP RELEASES COMPACT NEW 100MHZ 'DIGITAL ANALOG' SCOPES



Digital sampling 'scopes have been steadily growing in capability, while lowering in price to the point where they can compete with conventional analog instruments. But many engineers and technicians have still shied away from digital scopes, either because they couldn't get used to a push-button/menu system of operation, or were irritated by the delays which can often occur between adjusting the controls and seeing the display updated.

Such users will now find it much harder to stick with their old analog instrument, with the release by Hewlett Packard of two new compact 100MHz digital instruments that combine the familiar dedicated manual controls and 'speed of response' of an analog scope with the performance of a digital sampler.

All main operating controls of the two-channel HP 54600A and the four-channel HP 54601A are adjusted with dedicated rotary controls. HP engineers have also developed special custom ICs which give the scopes display-update response rates as fast as analog instruments, so that the instruments have the 'look and feel' of analog scopes.

At the same time, the advanced digital sampling circuitry inside provides uniformly bright, stable and flickerless displays, regardless of sweep speed — no more flicker at low speeds, or almost invisible traces at high speeds or high magnification.

And of course the scopes also provide features such as pre-trigger viewing and non-volatile storage, which are unavailable on analog instruments.

Key performance features of the new scopes include 100MHz repetitive bandwidth on both vertical and horizontal axes; 2MHz single-shot bandwidth (2MS/s); 2mV-5V/div vertical sensitivity; 2ns-5s/div range on both main and delayed timebases; 8-bit vertical resolution; automatic 1-key setup, with 16 setup memories; two trace memories; and an 'Autostore' facility which allows comparisons between a current waveform and its 'worst case' excursions.

Other features include dual cursors for manual time and voltage measurements; pushbutton hardcopy output to plotters and printers via optional parallel, RS-232C or HP-IB (IEEE-488) interfaces; and the ability to be fully programmed via the optional HP-IB or RS-232C interfaces.

Most of the usual calibration adjustments have been eliminated on the new instruments, which can be recalibrated at any time using custom software. This can be done in minutes, and does not involve opening the case.

Combined with the high stability and reliability provided by the surface mount technology and digital circuitry, this has allowed HP to give the scopes a three-year warranty.

Despite these impressive specs, the new instruments measure only 180 x 360 x 300mm (H x W x D) and weigh only 6.4kg — making them highly portable.

The prices are very impressive, too. The two-channel HP 54600A has a list price of $3895, while that for the four-channel HP 54601A is $4695. The three optional interfaces are each priced at $775.

With the new instruments clearly setting a new standard of performance in compact digital scopes, it seems likely that they will have a big impact on the 'general purpose' and field servicing markets.

Further details are available from Hewlett-Packard's Customer Information Centre; phone (008) 033 821. (J.R.)

GIGABIT LOGIC, TRIQUINT MERGING

GigaBit Logic and TriQuint Semiconductor have announced the signing of a letter-of-intent that will allow the two companies to be merged into one corporation. The new company will be jointly owned by existing investors, including Tektronix (TriQuint's previous sole owner), Digital Equipment Corporation, Analog Devices and NKT (of Denmark).

The merger will result in the world's largest merchant market producer of high performance gallium arsenide (GaAs) ICs, with combined revenues of more than twice its nearest competitor. The name of the new company will be TriQuint Semiconductor Inc. A distinct digital product line, which will include digital standard products and ASICs will be marketed under the GigaBit Logic name. A five-member board of directors will control the new company.

MINISTER VISITS AWA MICROELECTRONICS

The Hon Simon Crean, Minister for Science and Technology, has visited AWA MicroElectronics' design and manufacturing plant at Homebush in Sydney's west, to familiarise himself with its activities. AWAM is the only Australian company to design and manufacture custom chips.

The visit also marks a milestone in AWAM's history. During his visit, the Minister was presented with the one millionth chip which AWAM has designed and manufactured for one of its clients, Exicom. This is the first time that an Australian company has produced this many chips. The Exicom chip is an analog speech chip which is used in many domestic telephones.

By employing a custom-designed chip, Exicom has eliminated many of the components and made significant savings in production costs. It has also significantly increased its production volume.

SPECTROGRAPH ANALYSES 100 OBJECTS AT ONCE

Astronomers in California have developed a novel device that can analyse the light from as many as 100 distant stars of galaxies at the same time, paving the way for new types of studies that would take years using traditional observing techniques.

The device, called a 'multiobject spectrograph' contains 100 slender optical fibres that a robotic arm can move into preprogrammed positions in about five minutes. Although other astronomers have developed similar instruments, the multiobject spectrograph excels in its positioning accuracy — within one two hundredth of a millimetre for each fibre — and its large field of view, covering an area of the sky some five times larger than the full moon. These advantages make the device an ideal tool for creating three-dimensional maps of faint galaxies, studying how galaxies evolved, and probing extended objects like jets of matter expelled from the cores of active galaxies, according to Jean Brodie, assistant professor of astronomy and astrophysics at the University of California, Santa Cruz.

Brodie, who also is an assistant astronomer at UC Observatories/Lick Observatory, designed and built the multiobject spectrograph in collaboration with astrophysicist Charles Hailey and coworkers at the Lawrence Livermore National Laboratory. She plans to install it on the 120" Shane Telescope at Lick Observatory, after taking preliminary data on the observatory's 40" telescope.

NASA, ESA EXPLORING SATURN TOGETHER

NASA and European Space Agency (ESA) officials recently signed an agreement to cooperate in the development of the Cassini spacecraft to study Saturn.

NASA Administrator Richard H. Truly and ESA Director-General Jean-Marie Luton signed the agreement.

The Cassini spacecraft will explore the Saturnian system, which contains a host of volatile-rich bodies in a record of processes that have modified these bodies.

The Cassini spacecraft will be composed of the Saturn Orbiter, provided by NASA, and the Huygens Probe Sydney provided by ESA. It is currently scheduled for launch by NASA on a Titan (IV/Centaur vehicle in April 1966. NASA will provide overall Cassini mission operations and ESA will support probe operations.

The flight trajectory requires approximately seven years from launch to Saturn orbital insertion. Once at the Saturnian system, the mission baseline lifetime is four years.

The Saturn Orbiter will deliver the Huygens probe to Titan and will make repeated close flybys of Titan to allow intensive study of this moon. The mission will also conduct details observations of several other moons of Saturn, atmosphere and magnetosphere.

HUBBLE TELESCOPE STUDIES MASSIVE STAR

Astronomers working with the Goddard High Resolution Spectrograph, an advanced instrument on NASA's Hubble Space Telescope have reported on what they call the best spectrograms ever obtained of Melnick 42, a very massive star in a galaxy 170,000 light-years from Earth.

The report was presented to the meeting of the American Astronomical Society in Philadelphia by a team led by Dr Sally Heap of NASA's Goddard Space Flight Centre, Greenbelt, Md.

Dr Heap said that preliminary analysis of the spectrograms shows that Melnick 42 is between 80 and 100 times more massive than the sun,

NEWS HIGHLIGHTS

making it one of the most massive known starts.

Further, the analysis reveals that Melnick 42 is shedding its hot gases at a furious rate in a so-called 'stellar wind', that strips the star of an amount of gas equal in mass to the sun every 100,000 years.

She explained that Melnick 42 is a 'hot young supergiant' star in the Large Magellanic Cloud, a galaxy neighbouring the Milky Way. The star may be only two million years old, compared with the 4.6-billion-year age of the Earth. Melnick 42 has a surface temperature of about 86,000° Fahrenheit, or eight times hotter than the sun.

According to present theory, Melnick 42 will explode as a supernova within the next few million years, while the sun will continue to shine for several billion years. Dr Heap added that Melnick 42 is more than a million times bright than the sun.

CIMA ELECTRONICS TRAINING SEMINARS

Melbourne-based industry training organisation CIMA Electronics has provided details of the following seminars and training programs for the period to June 30:

Digital Design for ASICS: One day of theory plus an optional two days of practical work. Held in Melbourne on April 23, May 27 and June 24.

Analog Design Using Simulation: A workshop based on the use of PSPICE and PROBE. Held in Melbourne on April 11-12, May 29-30 and June 26-27.

Project Management: A course presenting the principles of project management. Held in Hobart on April 9, Melbourne on May 17.

PCB Design Techniques: A three-day workshop dealing with PCB design and post-design considerations for manufacture, testing and servicing. Held in Melbourne on May 7-9.

SMT Workshop: A practical training course of five days involving the design, layout, screenprinting, assembly, soldering and testing of a specially designed SMT project (a printer buffer). Held in Melbourne on April 15-19, May 20-24 and June 17- 21.

Four-bit Microcontrollers: A one-day course which concentrates on low-end devices in the NEC uPD75XX family. Held in Melbourne on April 30.

All Melbourne seminars are held at CIMA Electronics, 2nd Floor, 3 Chester Street, Oakleigh 3166.

For further information or to book into seminars and workshops, contact Dianne Hunt on (03) 563 1699.

PHILIPS CCTV MONITORS UK ROAD

Closed circuit TV has proved so successful in monitoring Britain's M25 motorway, one of the world's busiest, that the system will be extended to the new Dartford Bridge being built to ease the M25's congestion.

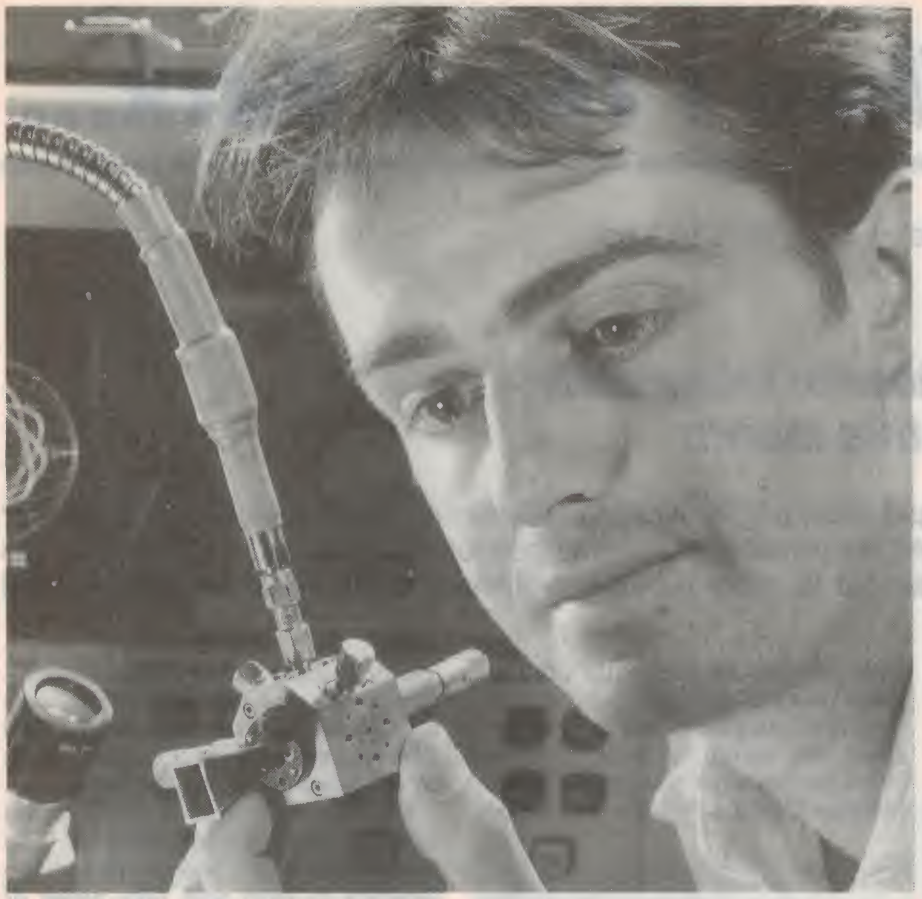
A total of 16 'video 50' and CCD monochrome cameras will be installed on the bridge in an order won by Philips. These cameras will feed pictures back to 33 monitors in a central control room, which also monitors M25 traffic through two tunnels under the River Thames.

The first phase of the UK Department of Transport's original $3 million contract with Philips, for the closed circuit television system on the M25 motorway, was successfully commissioned in mid 1990. This 20 camera system is monitored by Surrey Constabulary at the Godstone Control Office to survey motorway traffic on the 75km southern section of the M25.

It assists them in the implementation of immediate and effective traffic management in the event of accidents, bottlenecks, fog and general roadworks. The sophisticated control system for the cameras has been designed and developed by Philips engineers in

NEWS BRIEFS

- Electronics Trade Expo 1991 will be held in the Exhibition Building at the RNA Showgrounds in Brisbane on 8th and 9th May. Interested parties can see and compare the new release electronic products from Australia and overseas. Small as well as large manufacturers will be promoted.
- Perth's ***Switched On Living*** (The Electronics Expo) will now be held one week later than originally advertised. It will still be held at the Ascot Racecourse but from Friday, September 6 to Monday, September 9.
- ***IRH Components*** has been appointed distributor for Micro Semi Corporation's range of discrete semiconductor devices. Its main products are transient absorption zeners. Babcock Display Products of California has also appointed IRH its sole distributor in Australia and New Zealand. Babcock manufactures a wide range of display systems based on planar gas discharge and vacuum fluorescent technology.
- ***Promark Electronics*** will now provide a wide range of oscillators and filters, used in telecommunications, military, professional and data processing markets. The products are manufactured by STC Quartz, the largest crystal company in the UK.
- Another exclusive distributor arrangement sees ***Veltek Pty Ltd*** distributing the American company CSPI's vector and signal processing products for Australia and New Zealand. The CSPI Supercard is a member of the family of processors based on the Intel i860 microprocessor.
- Gary Mole, previously State Manager of the ***Utilux*** Queensland branch, is now filling the same position in Victoria. His main customer contacts will be split evenly between the Power & Switchgear and Industrial & Electronics divisions.
- Mr Donald Muir has been appointed as a Product Manager for ***Datacraft***'s LAN Systems Group. Mr Muir, formerly of Melbourne University, will combine his expertise in engineering consulting with developments in computing.
- Wanted: an Australian distributor for the hydrologic data collection systems of ***In-Situ Inc*** of Wyoming, USA. The systems comprise data loggers, water level and water quality probes and hydrologic software. Contact the US Consulate General; phone (02) 261 9200.
- ***Automation '91*** will be held in Melbourne from 26- 27 November. The Australian Institute of Engineers is calling for papers for the conference, which will focus on integrated, automated systems and the influence of the operational environment on the performance of systems.
- The Efes Convention and Exhibition Centre, under construction in Izmir, Turkey, will have ***Philips*** communication and security systems throughout, under a contract worth $2 million.
- Darling Harbour will be the venue for the ***Elenex Australia***, the third Australian International Electrical and Electronic Industries Exhibition, from June 30 to July 3. ***Automate Australia***, the second International Robotics and Industrial Automation Exhibition will also be held at Darling Harbour on the same dates.



Researchers at Bath University in south-west England, are working on devices and system for use in the millimetre and sub-nillimetre regions of the spectrum. The University's physicists have designed and fabricated millimetre-wave ICs involving multiple diodes and planar antenna structures with feature sizes as small as one micron. They're also working on resonant tunnelling devices, and a millimetre wave detector for operation to above 1000GHz.

the UK to provide police with pan, tilt, zoom and multiple pre-set shot facilities.

IR&D BOARD AWARDS $10.7M IN GRANTS

The Industry Research and Development Board has announced 13 new grants, totalling $10.7 million, awarded for research into information and communications technology — including video systems, lasers and robotics.

Chairman of the IR&D Board Mr Bill Kricker said the grants would provide support for strategic research likely to find wide application in Australian industry.

A major grant of almost $1.8 million for a project to develop an integrated video and communication system (universal video codec/terminal) suitable for future wideband optical fibre-based networks has been awarded to a team with researchers from Monash University, Siemens Ltd., Telecom Australia and the Australian Defence Force Academy.

Other major grants went to DSTO's Surveillance Research Laboratory and BHP Aerospace & Electronics ($1.9M), to develop bolometer infrared sensor arrays; CSIRO's Division of Information Technology and BHP Research and New Technology ($1.37M) for development of a parallel image processing and display system; CSIRO's Division of Exploration Geoscience and World Geoscience Corporation ($988,000) for a project to study rapid digital signal processing and control in airborne electrromagnetic remote sensing; University of NSW and Binary Engineering ($964,000) to develop speech codecs for high quality digital transmission over narrow bandwidth and/or noisy communications channels; and University of WA and CMTEK Pty Ltd ($892,433) to develop the technology to produce infra-red photodetectors made from semiconducting cadmium mercury telluride (CMT).

WINNERS OF OUR H-P DMM PROMO

As promised, here is a listing of the 30 lucky winners of our Hewlett-Packard sponsored *EA* Subscriptions Promotion, which ran in the magazine during October-December 1990.

The following subscribers were each winners of an HP E2377A handheld DMM, valued at $322 including tax:

Mr A. Waddell, Wavell Heights, Qld.
Mr A. Wilkie, Ocean Grove, Vic.
Mr M. Grant, North Rocks, NSW.
Mr R. Shankster, Smiggins Hole, NSW.
Mr K.N. Schokker, Burns Beach, WA.
Mr G. Ayton, Kings Park, NSW.
Mr S. Hain, Cooma, NSW
Mr T.J. Harrison, Wodonga, Vic.
Hydro-Electric Commission, Hobart, Tas.

The following subscribers each won an HP E2373A handheld DMM, valued at $188 including tax:

Mr G. Micallef, Kogarah, NSW.
Mr G. O'Rourke, East Doncaster, Vic.
Mr P.C. Baker, Mooroolbark, Vic.
Mr G.P. Jelley, Mooroolbark, Vic.
Mr C.J. Kenney, Katanning, WA.
Mr Pantelejenko, Plenty, Vic.
Mr Kochovski, Wollongong, NSW.
Mr Nickols, Penguin, Tas.
Mr L. Freund, Para Vista, SA.
State Emergency Service, Hobart, Tas.
Mr C.G. Bahr, Townsville, Qld.
Nicholsen Electronics, Glenorchy, Tas.
Mr R. Cashion, Leslie Vale, Tas.
R&D Electronics, Maroochydore, Qld.
Telecom Australia, Melbourne, Vic.
Mr R. Hilderbrand, Yarrawonga, Vic.
Mr R. Baker, Summer Hill, NSW.
Mr K.G. Irving, Highett, Vic.
Queensland Police Dept., Alderley, Qld.
Mr G.S. Turner, Waitara, NSW.

Our congratulations to all of the lucky winners, and thanks to everyone who subscribed or renewed their sub during this period. Thanks also to Hewlett-Packard Australia, for its sponsorship.

When I Think Back...

by Neville Williams

Samuel Morse: pioneer of telegraphy, born 200 years ago this month

Few devotees of electronics would show any hesitation in identifying Samuel Morse as a pioneer in telegraphic communication and the inventor of the time-honoured Morse code. What is not so well known is that initially, he set out to make a name for himself in the realm of painting and sculpture.

My venerable *Chambers' Biographical Dictionary* (London, 1926) records that Samuel Finley Breese Morse was born on April 27, 1791 at Charlestown, Mass., USA — just 200 years ago this month. He was the eldest son of Rev. Dr. Jedidiah Morse and his wife — described elsewhere as 'highly educated and cultured parents'.

In his article 'The Genius of Samuel Morse' (*Readers Digest*, 1945, condensed from *Esquire*) writer Kurt Steel adds that Pastor Jedidiah was a personal friend of Presidents Washington and Adams.

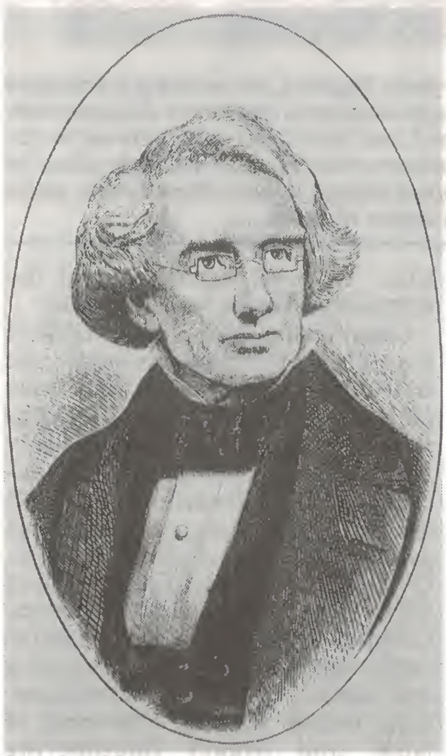
As a geographer, as well as a cleric, he was the author of *The American Universal Geography* and *The American Gazeteer*, books which served to create a public awareness of the family name, and to provide the funds necessary to send Samuel and his two younger brothers to college.

Samuel graduated from Yale in 1810, with a passion for art and a keen hobby-level interest in electricity, which he attributed to 'Mr Day's lectures' on the subject, supplemented by other information which he sought from academics working with the new 'fluid'.

Significantly, also, he studied chemistry under Professor Silliman — later, editor of *American Journal of Science and Arts* — and witnessed practical experiments with voltaic cells.

While at college, however, Samuel Morse spent much of his spare time painting miniatures of his friends on ivory, at five dollars apiece. It seemed only logical that, following graduation, he should apply his obvious talent on a full-time basis.

At first, his parents had reservations about him taking up art as a career but, when his work was praised by the famous Gilbert Stuart — portrait



painter for presidents Washington, Jefferson, Madison and Adams — they consented to their 19- year-old son visiting England to study English and European painting styles under American ex-patriot artist Washington Allston. This was in 1811.

Two years later, at the tender age of 22, he gained international recognition when one of his pictures was ranked in the first nine out of two thousand exhibited at Somerset House by the Royal Academy in London.

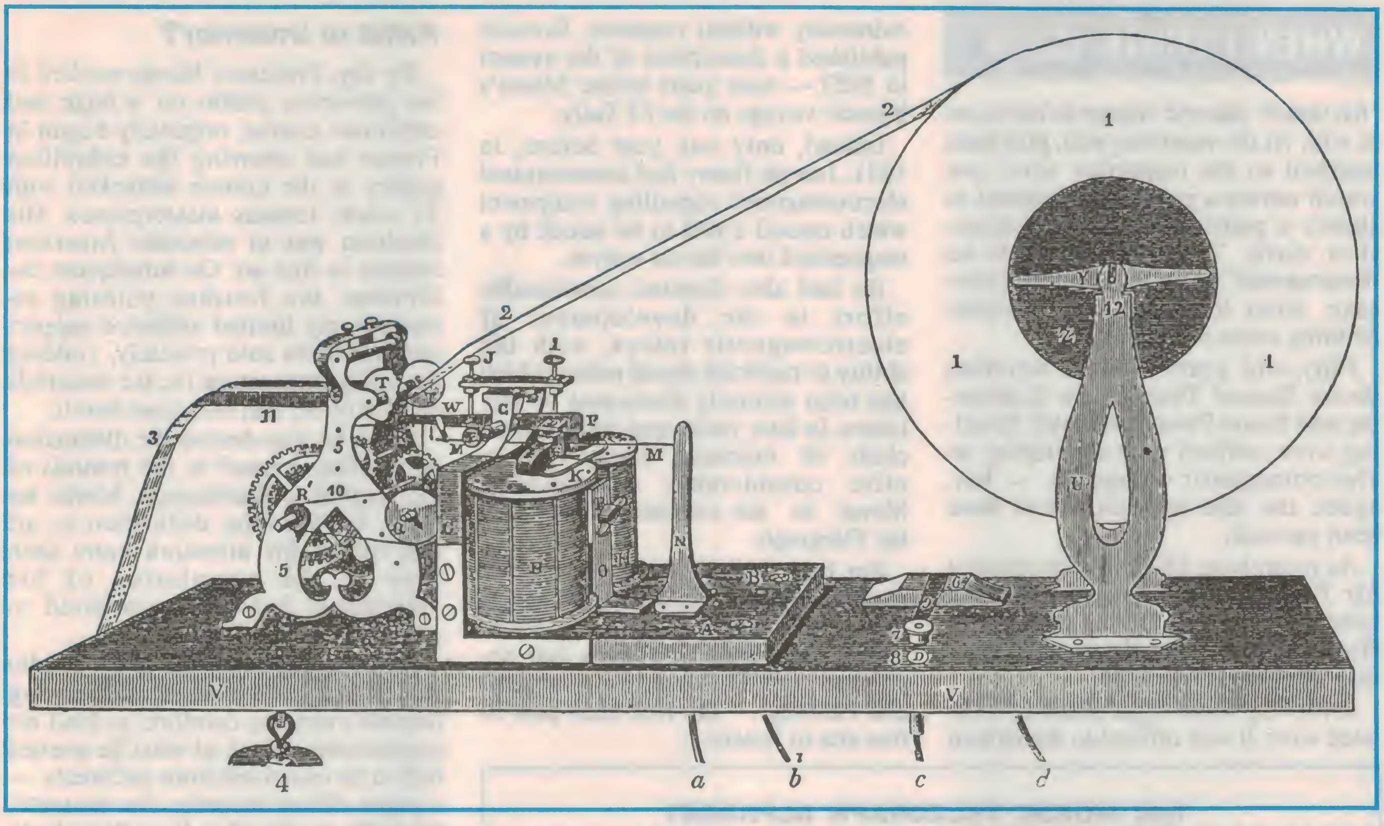
Having also won a gold medal award in 1813 for his statue of 'The Dying Hercules', Morse returned to America in 1815 with high hopes of winning similar acceptance in his own country to that available in Europe. It was not to be, however, and he had to eke out a living painting portraits for a totally inadequate return. His most famous, that of the veteran American General Lafayette, was hung in the New York City Hall.

Unfortunately, demand for his work was further affected by a national economic downturn and, while his ability was never in dispute, he experienced a considerable degree of financial hardship over several years, which he was at some pains to conceal.

Fate intervenes

Despite the financial setback, he was a foundation member of the National Academy of Design in New York and served as its first president during the years 1826-42. It was during this period that Morse's career was diverted by a quirk of fate, which effectively transformed Morse the artist into Morse the inventor.

In October 1832, he was returning home from a second visit to Europe — in the role of an artist. One evening, on the voyage from Le Havre to New York, shipboard conversation turned to electricity and Morse startled his fellow passengers by speculating



Morse's electric telegraph as used on the experimental line between Baltimore and Washington. (From 'Communication Through the Ages' by Alfred Still. Murray Hill Books, New York, 1946).

whether information could be 'instantaneously transported by electricity to any distance'.

To Morse, it was by no means a new idea. When the USA had declared war on England in 1812, the US administration had no way of knowing that, two days before, the British Parliament had taken conciliatory steps that could well have averted the conflict altogether. In London at the time, and acutely aware of the tragic irony of the situation, Morse had written to his parents in Boston lamenting the fact that there lacked the means to transport messages across the Atlantic 'with the rapidity of thought — in an instant'.

Coming across the document years later, Morse scribbled in the margin: 'Longing for a telegraph, even in this letter'.

Now, in mid-Atlantic, some 20 years later, he became totally obsessed with the idea. He sought to recollect and apply facts about the electric fluid which he had absorbed in the pursuit of a secondary interest dating all the way back to Mr Day's lectures at Yale.

By the time he landed in New York his artist's sketch book, which might otherwise have been taken up with shipboard images, was occupied instead by technical sketches, said to be notable for their perception and clarity.

In his book *Guglielmo Marconi* (Heron Books, UK, 1970) David Gunstan quotes a remark by Morse to the Captain as he disembarked: "Should you hear of the telegraph, one of these days as the wonder of the world, remember the discovery was made on the good ship *Sully*".

Inventor or visionary?

Translated into 'hardware', Morse's sketches became primitive prototypes for practical communications equipment.

But while he is regarded, especially in America, as the inventor of the electric telegraph, his true genius invites comparison with that of Marconi, some 60 years later: a special talent for developing and applying the ideas of others to create practical equipment.

To quote Gunstan again:

Morse was not a scientist. His contribution to science was more his vision of the possibilities of long-distance communication, and his ability to get people to support him in his attempts to build a communication system.

It is a matter of record that the shipboard debate was initiated by a certain Dr Charles Thomas Jackson, who presented a lecture on the subject of electricity to while away a couple of tedious hours at sea. During the lecture, he demonstrated the principle of the electromagnet — as conceived by William Sturgeon and the physicist Professor Joseph Henry.

It was Morse, rather than Jackson, who saw in the electromagnet a 'terminal' device, which could respond physically to an electric current fed to it along a wire line from a remote source. More precisely, a device that could actuate a pen to imprint meaningful marks on a narrow, moving strip of paper. To quote Gunstan, mentioned above:

This, of course, was the ancestor of the reliable Morse inker, used so much by Marconi in his own experiments, years later.

It is reasonable to assume that, in the debate aboard the *SS Sully*, mention would have been made of earlier suggestions or attempts at signalling by means of electricity. For example:

Earlier suggestions

As early as 1753, a writer 'C.M.' (possibly Dr Charles Morrison of Greenock, Scotland) had suggested stringing 30-odd lines between distant points, with provision to apply a

'frictional' electric charge to each one at will. At the receiving end, pith balls attached to the respective wires one would attract a paper flap, marked to signify a particular letter or punctuation mark. This would allow an 'emanuensis' to write down the message, letter by letter, as it arrived. Nothing came of the idea.

Fifty-odd years later, a Bavarian doctor Samuel Thomas von Sommering and Baron Pawel Lwowitch Schilling were credited with developing an electromagnetic telegraph — but, again, the idea appears not to have been pursued.

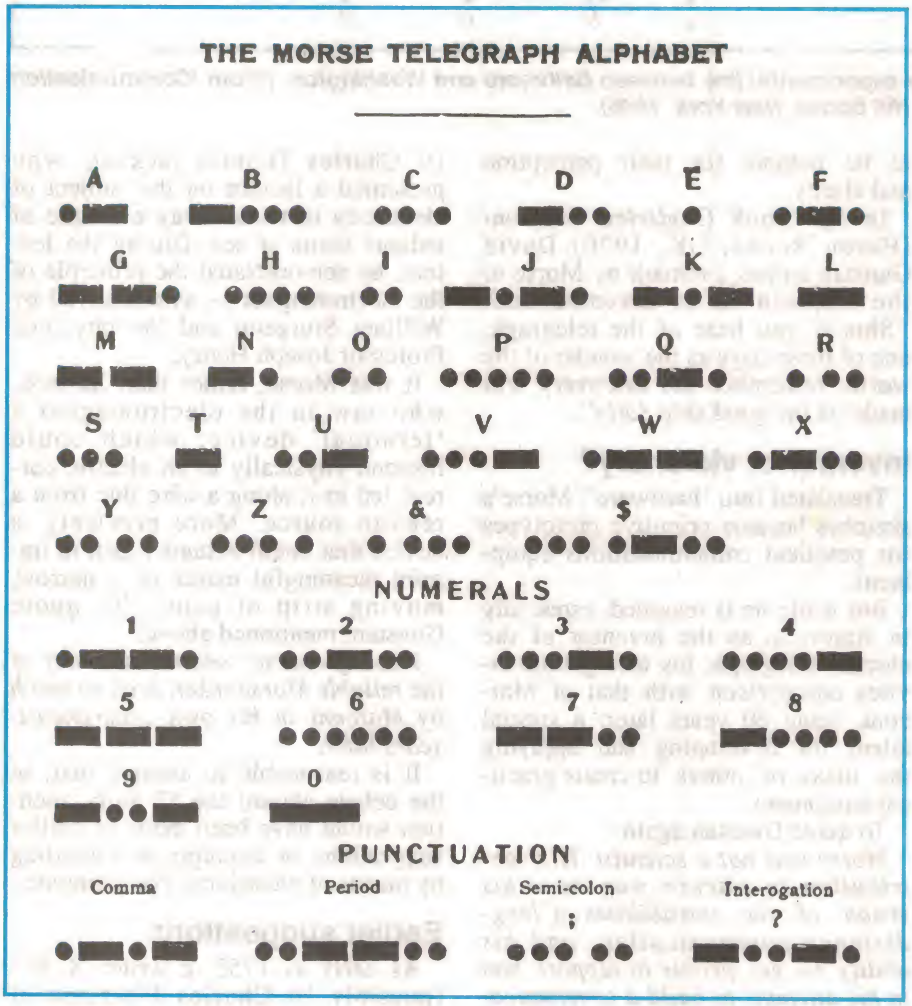
As recently as 1816, British scientist Sir Francis Ronalds had set up a telegraphic system on his property at Hammersmith using 'frictional' rather than 'flowing' electricity.

Involving some eight miles of insulated wire, it was offered to the British Admiralty without response. Ronalds published a description of the system in 1823 — nine years before Morse's historic voyage on the *SS Sully*.

Indeed, only one year before, in 1831, Joseph Henry had demonstrated electromagnetic signalling equipment which caused a bell to be struck by a magnetised iron bar on a pivot.

He had also directed considerable effort to the development of electromagnetic relays, with the ability to replicate signal pulses which had been seriously attenuated by line losses. In later years, and despite some clash of interests, Henry was to offer considerable assistance to Morse in the commercialisation of his Telegraph.

But back in New York, Morse embarked upon a veritable double life. A few months before, the newly established New York University had appointed him Professor of Sculpture and Painting — the first such post in fine arts in America.



The original Morse code or 'alphabet', as shown in the 'Manual of Wireless Telegraphy' published circa 1912. It evolved into the present-day 'continental' or 'international' telegraph code which is still commonly referred to as 'Morse'.

Artist or inventor?

By day, Professor Morse worked in his university studio on a huge and ambitious canvas, originally begun in France and showing the exhibition gallery at the Louvre bedecked with 37 world famous masterpieces. His ambition was to stimulate American interest in fine art. On subsequent exhibition, the finished painting attracted only limited audience support and had to be sold privately, yielding the artist scant return for the materials and the effort that had gone into it.

When he was denied the distinction of painting a panel in the rotunda of the Capitol at Washington, Morse set aside his life-long dedication to art and turned his attention more than ever to the completion of his 'Telegraph' (which he preferred to spell with a capital-T).

He spent his evenings in the studio working on his brainchild and denying himself everyday comforts to fund his experiments. Much of what he needed had to be contrived from oddments — a paper ribbon recorder, for example, from the works of a discarded clock; inductors from silk-covered wire produced at the time for high-class milliners, making ladies' hats.

In his book *Amber to Amperes* (New York and London, 1931) Ernest Greenwood quotes from Morse's own notes to indicate the problems which he faced at this time:

Up to the autumn of 1837, my telegraphic apparatus existed in so crude a form that I felt a reluctance to have it seen. My means were very limited — so limited as to preclude the possibility of constructing an apparatus of such mechanical finish as to warrant my success in venturing upon its public exhibition. I had no wish to expose to ridicule the representative of so many years of laborious thought.

To conceal from my friends the stinted manner in which I lived, I was in the habit of bringing food into my room in the evenings and this was my mode of life for many years.

Limited as his means may have been, the overall system envisaged by Morse made undeniably good sense:

- It relied on a single circuit, involving normally one pair of wires or, conceivably, a single wire with the earth itself providing a return path for the current.
- For the actual code, alphabetical characters, numerals and essential punctuation marks would all be

represented by discrete combinations of short and long pulses — dots and dashes — with the simpler combinations reserved for the most commonly used characters. Devised in collaboration with a friend, Alfred Vail, the 'Morse' code was patented in 1840.

- A relay, modified to operate as an inker, would record the dots and dashes on moving paper tape, creating a permanent and readily readable record of all messages.
- By providing a sending key, an inker and current source at each end of the line, two-way working would be readily possible.
- The system provided scope for higher speed with skilled operators, with the ultimate possibility of attaining even higher speed with mechanical sending aids (e.g., prepunched tape).

Morse's first successful demonstration, circa 1840, was over a distance of 10 miles (16km), but his troubles were not over by any means. Despite early support from Leonard Gale, the Vail family (of Morristown Iron Works) and Congressman F.O.J. Smith of Maine, Morse was left largely to battle on his own — not an easy task for someone better known at the time as an artist than a scientist.

There were arguments, too, between Morse and his supporters, such that he wrote: 'The condition of an inventor is, indeed, not enviable'. At this low point in his morale, Morse appears almost to have given up, turning his attention temporarily to photography. (See panel).

In 1843, Congress finally voted $30,000 to build a 40-mile (64km) experimental telegraph line between Washington and Baltimore — a far from unanimous decision, with some of the legislators proclaiming the whole idea so 'silly' that they framed a cynical amendment suggesting that some of the allocation should be diverted to the support of mesmerism!

The public at large showed little interest in the idea. Landowners commonly refused permission for lines to cross their property, and one group of farmers even destroyed a section of overhead line because it was allegedly 'taking electricity from the air and spoiling the weather'.

Morse's original plan had been to run the wires underground in lead pipe, and Ezra Cornell, who later founded the Cornell University, devised an ingenious plough which in one operation trenched, laid and covered the cable. Unfortunately, $23,000 down the track Morse discovered that the cable insulation was not equal to the task and he was faced with the problem of somehow abandoning the procedure without bringing the whole project into disrepute and triggering a major political scandal.

A very resourceful Cornell solved his problem by assembling an eight-yoke team of oxen and deliberately driving his beloved plough into a boulder, wrecking the plough completely.

The unfortunate 'accident' gave Morse the excuse he needed to string the wires on poles, instead!

Samuel Morse — photographer!

Thoroughly discouraged by the lack of official support for his telegraphic research, Morse turned for a while to the new science of photography.

In Paris, he had met and become friendly with Louis Daguerre and, in April 1839, described Daguerre's work to the American public. In the process, he probably built the first camera in America and with his help, Professor J.W. Draper, scientist and author, made the world's first photographic portrait on the roof of Morse's studio at the New York University. This was in 1839.

By 1841, Morse and Draper had reduced exposure time from five minutes to a few seconds, and Morse was conducting classes in what had become the new art.

Morse the family man

Encouraged by his early acceptance in Europe, Samuel Morse married Lucrecia Walker, a beautiful young woman who was interested in art and fully supportive of her husband's efforts to win recognition as an artist in his own country. In due course she bore him three children: Susan, Charles and Finley.

They were a devoted couple, but Sam Morse's lifestyle as an itinerant artist-cum-inventor took him away from home for long periods — a separation that was heightened by the apalling travel and communication facilities in a new, large and sparsely populated country.

Sadly, just when Morse was able to plan realistically for a new home in the East for the whole family, he received word that his wife had died suddenly from a heart attack. In his absence, his children had been placed in the care of relatives.

Morse was devastated, but his answer to grief was to provide first for his children and then to apply himself to his prime interests: his art and the Telegraph.

First US telegraph

The line was not actually completed until 1844 and on the morning of May 24 in that year, it carried the historic phrase 'What God hath wrought' — received by Alfred Vail in Baltimore during a ceremony in the Supreme Court Chambers.

Given his family background, Samuel Morse presumably considered it appropriate to accord the ultimate credit for the invention to the Almighty, a sentiment that would not have seemed out of place in contemporary American society.

The first functional use of the cable was to provide Washington with progress reports of the Democratic convention in Baltimore. Its reputation was made when the delegates responded to the call: "Three cheers for James K. Polk, and three cheers for the Telegraph!"

The Washington-Baltimore link became the first of many telegraph lines in the USA, all of them installed by private enterprise and most of them using Morse's technology.

It was also taken up by the governments of several European nations, and representatives of 10 such met in Paris in 1858 'as an honorary testimony to the good he (Samuel Morse) had conferred upon mankind'. This unusual tribute — for an inventor — was supported by an honorarium of 4000 francs, which were no doubt more than welcome.

At the same time, Morse was not without his detractors, who insisted that the adulation bestowed on Morse was out of proportion to his real achievement; that it failed to recognise the contribution of other pioneers, including that of Joseph Henry. They also recalled that, in 1846, Alexander Bain, a Scottish academic had been granted an English patent for a printing telegraph that relied on electrochemical rather than electromagnetic technology.

Incoming electric pulses were recorded by applying them to a paper ribbon which had been sensitised with potassium cyanide. It proved capable of working over considerable distan-

ces without the use of relays as, for example between Boston and Buffalo via New York.

International overtones

Despite this, Bain was denied an American patent in 1849 on the grounds that it infringed the Morse patent — a refusal that was subsequently overturned by the US High Court. Some maintained that the real motivation was a payback for British reluctance to recognise the work of Morse. It is also a fact that, in 1828, New York inventor Harrison Gray Dyar had put forward the idea of an electrochemical printing telegraph in which spark electricity would be applied across a moving strip of litmus paper.

In the UK, attention tended to focus on William Fothergill Cooke and Professor Charles Wheatstone, who formed a somewhat uncomfortable partnership in 1837 with the aim of developing ways of communicating over a distance by means of electrical circuits.

Who contributed most to the partnership is a matter for argument, but *Chambers' Biographical Dictionary* credits them jointly with laying the foundation for the telegraph system of the UK — such that they were for the Old World what Morse was for the new. Shown here is a facsimile of a handbill issued in 1845, announcing the public exhibition of a telegraph system operating between Paddington and Slough.

With Morse having been honoured in Paris, Wheatstone and Cooke ultimately received the Albert Gold Medal in the UK in 1867. Wheatstone was knighted in 1868 and Cooke in 1869. International rivalry and court disputed patents aside, the electric telegraph was adopted widely during the latter half of the nineteenth century, with a cross-Channel link being set up in 1858 — only to break after three week's operation.

Sorry about that!

Failure of the Channel link must have brought bitter memories to Morse, who had begun to explore the the possibility of undersea cables as early as 1842.

In that year, from a rowboat, he had personally laid a cable between the Battery and Governor's Island in

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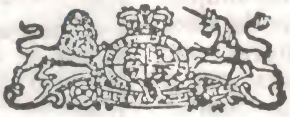

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N.B. Messengers in constant attendance, so that communications received by Telegraph, would be forwarded, if required, to any part of London, Windsor, Eton, &c.

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Facsimile of a handbill issued in Britain in 1845. Early telegraph systems in Britain were a monopoly controlled by a company established by Cooke in 1846. They were acquired by the British Post Office in 1872 and became a public service.

New York Bay. Early in the morning of the very day on which the cable was to have been publicly demonstrated, Morse watched in dismay as the skipper of a fishing smack hauled up the strange wire on his anchor and casually chopped it through, leaving the two ends to fall back into the water!

In *The Electronic Revolution* (Penguin, London, 1967), S. Handel notes that the most obvious and urgent applications for the electric telegraph had to do with railway systems, and the transmission of financial information to do with goods and shares, especially between London and New York.

He also notes that the first successful trans-Atlantic cable linking London and Wall Street was laid in 1866, thereby fulfilling Morse's earliest dreams. Regarded at the time as the high point in applied science, it required all the experience and ingenuity of the great physicist Lord Kelvin and the resources of the Anglo-American Telegraph Company, of which Kelvin was a director.

By the turn of the century, the world was criss-crossed by intra- and inter-

continental telegraph circuits. Companies like Anglo-American and Western Union were so entrenched and so smug that they were more interested in frustrating rather than investigating the telephone and wireless communication systems being championed independently by Bell, Marconi and others.

In the meantime, telegraphic systems had gravitated largely to Samuel Morse's technology and code or derivatives thereof, with Wheatstone most commonly credited with pioneering a sub-revolution in code transmission speed.

High speed telegraphy

With manual operator sending, the transmission rate was limited to about 30-35 words per minute.

The Wheatstone system involved pre-recording all messages on a machine, which punched a pattern of holes in paper tape. The punched tape would then be fed into the system at high speed and the characters recorded at the same speed by the distant inker.

No longer dependent on the dexterity of the operators, the sending speed was limited mainly by the performance of the terminal equipment, with 600 words per minute being typical.

His dreams fulfilled, Samuel Morse eventually returned to Yale as Professor of Natural History, by then accepted and honoured as a scientist rather than an artist. He died in New York in 1872, having spent the last years of his life as a philanthropist and an 'armchair' politician — with a record of supporting lost causes. In his day, he had nominated unsuccessfully as mayor of New York, had been stubbornly opposed to the Civil War and had campaigned furiously against the re-election of Lincoln.

But Morse the artist had not been completely forgotten. In 1932, 60 years after his death, the Metropolitan Museum in New York honoured his memory with a one-man exhibition of his work.

In the *Esquire/Reader's Digest* article Kurt Steel, mentioned earlier, remembers him as 'primarily an artist — and a very fine one'. He observes, furthermore, that whereas his telegraphic system has become progressively less relevant in the face of modern communications technology, his paintings and in particular his portraits grow more valuable with every passing year. ■

THE SERVICEMAN

The old Thorn CTV with a stubborn case of the shakes!

I have just completed the most frustrating job that it's ever been my misfortune to take on. During the months it took to solve, the fault confounded several experts yet turned out to be the simplest and most unexpected component in the set. You probably won't believe this story, but I assure you it is perfectly true.

The set concerned was an old Thorn model 9105 colour TV. It was one of those English chassis that appeared at the beginning of colour broadcasting here. Most of these have disappeared, their tubes having long since succumbed to thousands of hours of viewing.

This one arrived in the arms of its owner. I suggested that he take it straight back out to his car, but he would have none of it. I tried to explain that the set was too old to be economically repaired.

Almost every set of this vintage that I come across these days has a worn out picture tube. Some of the small screen sets are not too bad, but this was a 22" screen and I couldn't see how it would ever produce a picture that would justify the time and expense of repairs.

Besides, this model is a villainous thing to work on. The power supply and line output boards are extremely awkward to service. The copper sides of the circuit boards cannot be exposed without unsoldering numerous connections. And of course, it cannot be tested until the boards are replaced and the leads resoldered.

All in all, it's a set I am happy to say is all but extinct, around my particular area.

Anyway, I found myself lumbered with this one and decided to give it a go as the workshop was not too busy just at that time.

The symptoms were simple enough. The set wouldn't work. The owner said that it had just stopped while they were watching something the night before. The only help he could offer was that there had seemed to be a 'spark' from the back of the set, and a small puff of smoke.

I didn't attach too much importance to the 'spark' — many owners see a flash of light on the screen and believe that it was a something from inside the set. Particularly so if the set stops working then, or very soon afterward. But here I was more concerned about the puff of smoke. There's no way *that* could be confused with light on the screen.

So the first thing I did was to remove the back of the set and have a good look around for any damage. And damage there certainly was.

In this model the convergence board is a large PCB that hangs down the back of the set, level with the tube base. It carries most of the convergence components, as well as the beam switches and the screen voltage adjustment pots.

There was no difficulty finding the source of trouble in this case. The right-hand side of the board showed heavy smoke stains spreading upwards from near the bottom corner.

Many of the convergence controls are high wattage, wirewound pots and these are often found dry jointed or burnt up. I thought I would find one of these done for and although I have a large number of these pots salvaged from other sets, Murphy usually ensures that the one I want is never among them!

Lucky — at first

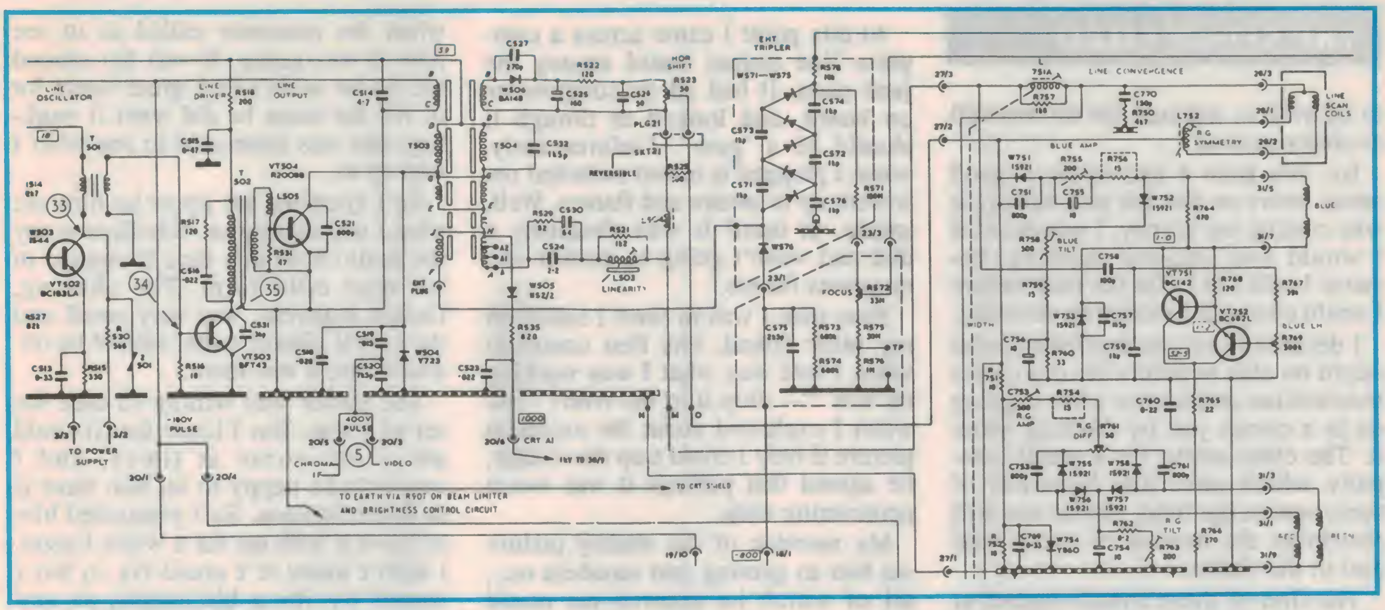
This time I was lucky, (or Murphy was on holidays). It wasn't a pot that was burnt, but a small tubular ceramic capacitor (C758) that had become dry jointed. This cap is directly connected to the collector of the line output transistor, so it carries high voltage, high current pulses.

Once a dry joint opens in this kind of circuit, the pulses easily span the gap as tiny sparks. The sparks erode the board material and very quickly the small sparks become big ones, with the consequent smoke and flames. This is what had happened this time.

There was no difficulty in repairing the board, and finding a suitable replacement capacitor. I did a resistance check on all the fuses and the chopper and line output transistors, just in case the fault had caused an overload in those components.

Everything appeared to be OK, so I switched on. The set fired up normally, and soon there was a very good picture on the screen.

In fact, I was astounded at the quality of the picture — it was just as it was when the set was new. The only reason I can suggest is that the set must have had a new tube fitted at some time in its more recent past. It



The line output, picture centreing, EHT and convergence circuitry of the old Thorn 9105 CTV. In searching for the cause of the set's 'shakes', the Serviceman spent a lot of time checking components in the picture centreing circuit, just to the left of the EHT tripler in the upper centre here. C758, the cause of the original problem, is at centre right near VT751.

was an ex-rental set, so that could be the explanation.

So the picture justified the owner's desire to have it repaired, but it landed me with the problem job mentioned at the head of this story. Because as I watched the picture, I noticed that it was shaking sideways slightly.

It wasn't a regular shaking, but would shake for a few seconds then stop for half a minute or more. Sometimes the shakes were very slight and almost acceptable, but at other times they were quite violent and were really unwatchable.

I wasn't sure if the shakes were a result of the burnup, or another fault altogether. But whatever the cause, it would have to be found and fixed before the set could go home.

To begin with, I considered what might cause the picture to shift sideways.

The most obvious fault would be mistiming of the horizontal flyback. When this occurs, it is usually on a short-term basis and causes vertical lines to take on a distinct wriggle. If it occurred slowly enough, it could give the appearance of the picture shifting.

I spent considerable time setting up my oscilloscope to compare flyback against the sync pulses, but all to no avail. As far as I could see flyback was as steady as a rock and exactly in time with the sync pulses.

So if it wasn't flyback timing, could it be flyback amplitude? Admittedly, a fault here should show picture displacement in equal and opposite directions — not just a total shift one way then the other. In any case careful examination of the pulse at the collector of the line output transistor showed not the slightest trace of irregularity. The pulses were exactly as specified and rock steady.

While I was investigating the line output stage, I also checked the HT rail for signs of instability. But even with the CRO gain turned right up, there was only a millivolt or so of noise and no sign of 50Hz hum or other irregularities.

Horiz. centreing?

So, if there was nothing wrong with the line output, the problem then had to be in the horizontal centreing. To check this I had to have a steady signal, and the best signal is one or other of the test patterns. I do have a signal generator that can give a crosshatch and circle pattern, but the most convenient pattern is the PM5544 signal transmitted for most of the day by SBS stations.

The Thorn 9105 does not have a UHF tuner, but I overcome problems like this by having an old video recorder wired into my workshop antenna system. This gives me a PM5544 pattern off air while SBS is available, and off tape when it is not.

The test pattern showed very clearly that the whole picture was indeed jumping sideways. It was moving to the left by an amount varying from 5mm to as much as 15mm.

In most sets, the horizontal centreing circuits introduce a small positive or negative DC current into the yoke to move the picture. If there was a fault in this circuitry it could produce the symptoms seen here. So I set about tracking down the circuit.

The control voltage is generated in a winding at the top right of the line output transformer (pins B & C). It is rectified by W506, filtered by C525, R522 and C526 and impressed across potentiometer R523.

The current flows via a reversible plug and socket and inductor L504, to join up with the main horizontal deflection current from the horizontal linearity coil L503. If there was an intermittent fault in any of these components, it could give rise to just such symptoms as I was seeing.

The centreing components were tucked away in one corner of the line output circuit board. They weren't easy to find, because the component numbers were printed with black ink on a board that had gone nearly black with age. In the end I had to find a similar board from a junked set and use that to identify the parts I was looking for.

Because of the time-consuming need for unsoldering and resoldering the many leads interconnecting the various parts of the board, I chose to replace all the components on the doubtful board with (presumably) good parts taken from the junk board. Of course, I tested them as thoroughly as I could before fitting them, but all

THE SERVICEMAN

to no avail — because the set was still as shaky as ever.

By this time I had spent a good many hours on the job and already it was costing me money. I wondered if I would ever recover anything, because I still had to fix the fault before I could charge the customer anything.

I decided to call on two friends who might be able to help. One is a clever theoretician and knows what is going on in a circuit just by thinking about it. The other works for a rental company which once had hundreds of these sets in the field, and he can still remember the number of every vital part in the chassis.

The first of these friends looked at the symptoms and cogitated for a few minutes before announcing "DC in the yoke!" In his opinion, it had to be unwanted DC flowing in the yoke, not necessarily from the picture centreing circuit.

We studied the circuit together for half an hour or more, but finally came to the conclusion that there was simply nothing that could cause the problems, other than a fault in the centreing circuit.

So once more I set about replacing all the centreing components, this time with new parts rather than salvaged parts from junked boards. But it didn't do any good. The picture was still shaking as badly as ever.

At this point I came across a complete line output board among the junk parts. It had all its components on board, and looked as though it should be a 'goer'. Unfortunately, when I plugged it in and switched on, it went up in smoke and flames. Well, *smoke*, at least! It was obviously a dud and wasn't going to answer any questions for me.

Next time I was in town I called on my other friend. His first comment when I told him what I was working on was "— drop it in the river!" But when I explained about the excellent picture if only I could stop the shakes, he agreed that perhaps it was worth persevering with.

My mention of the shakey picture set him to quoting part numbers etc., all of which he assured me could cause my troubles. There was no way I could remember the numbers until I got home, let alone for something like 10 years, as he was doing.

He could not only remember the part numbers but also the circuit values, and just whereabouts on the board they were located. I had to write it all down and when I checked later I found that he was spot on. I wish my memory was that good!

Anyway, his advice, although well intentioned, did nothing to alleviate the symptoms on the old Thorn. I replaced every component he listed, but still the picture shook uncontrollably.

By now the set had been sitting in the workshop for about three months, when the customer called in to see how it was going. It was his second set, so he wasn't in a great hurry for it. All the same he did want it working, and was interested to see what I was up to.

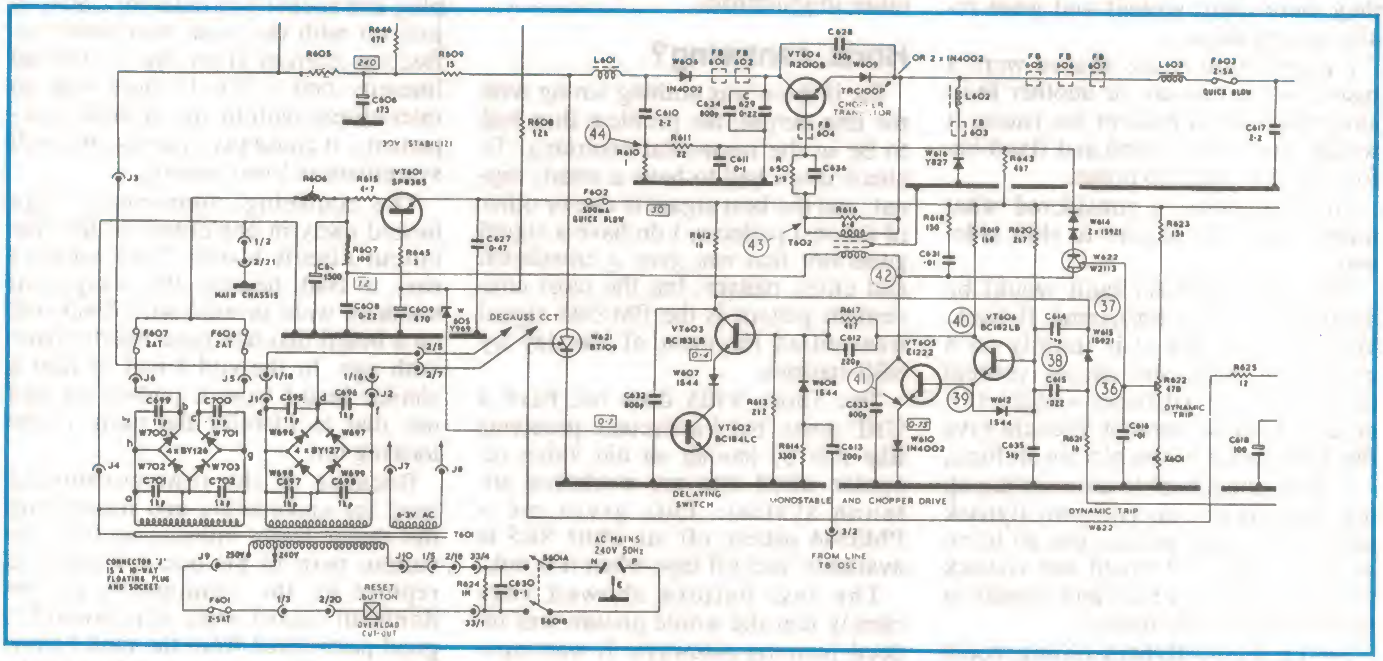
So I fired the set up to let him see what I was up against. Needless to say the fault chose this time to appear in its most mild form. The shaking, though apparent, was very small and the casual viewer might almost be unaware that it was there.

The owner was willing to take the set as it was. But I knew that it could get a lot worse at times, and I wouldn't be happy to let him have it in that condition. So I persuaded him to leave it with me for a while longer. I didn't know if I could fix it, but I would try for a bit longer, as and when spare time became available.

The set sat on a corner of the bench, glaring at me whenever I went near it. The thing seemed to have a mind of its own, and wasn't going to reveal its secret easily. The big problem was that most of the time the shaking was very slight and the cause, whatever it was, so minor that it would be very hard to find.

All I could do for the next few weeks was to let it run each day, and attack the problem on the odd occasions that the fault appeared in its 'bad' form.

Whenever my CRO was not being used for another job, I left it connected to one part or another of the



The power supply section of the Thorn 9105 circuit. The elusive — and quite unexpected — 'real' cause of the set's intermittent horizontal picture shake turned out to be here, in the form of a faulty component. Can you guess which one?

Thorn. I hoped that eventually, I would hook it onto some part of the circuit that would turn out to be moving in sympathy with the fault on the screen.

After all this time, I knew that the fault wasn't in any of the obvious parts of the circuit and would just have to trust to luck, hoping that one day I would find out where it was.

Over recent years I have junked a lot of these old Thorns. I have kept many of the boards for spare parts and disposed of the tubes and cabinets. But one day I realised that not all the tubes had reached the tip. There was still one outside the workshop and it still had its yoke attached.

The yoke, perhaps?

After four months, as you might well understand, I was grasping at straws and was prepared to do anything that might solve the problem. So I changed the yoke.

This is not an easy task in old delta-gun tubes. It's not just a matter of swapping the yoke from one tube to the other. Purity, static and dynamic convergence adjustments are all critical and vital to picture quality and they take considerable time.

I don't think I really expected any improvement, so I wasn't disappointed when the new picture was the same as the old. So, I decided that it would have to go back, fault or no fault. There was just nothing else I could think of to be done.

I called the owner and told him that I was going to give up on the problem. He said he would come in next day, so I set about readying the set to go home.

As I pushed the cabinet back into place, the picture on screen blacked out briefly. I wasn't sure just what had happened, so I removed the back and started again.

Over the next few minutes I found that if I put the back in place roughly, the picture would black out. Replacing it gently gave no such result. So it looked as though I had another fault in this so-and-so set, although it did seem as though this one was going to be easier to find.

At first the fault would only show up as I tried to push the cabinet back into position, but I soon found that it was actually pressing on part of the power supply heatsink that caused the fault. After that I could make it come and go more or less at will.

I carefully checked the top circuit board and all the connections to it. There was nothing amiss, and no amount of poking and prodding of components would produce the fault symptoms.

Next, I turned the power supply assembly over and slipped a thick sheet of cardboard under it to prevent any accidental shorts to frame.

It took only a moment to find the cause of the brief shut-downs. One end of resistor R615 was dry jointed. R615 feeds the 30-volt regulator, which in turn supplies the line oscillator. So any loss of the 30V rail stops the line stage and blacks out the screen. But resoldering R615 only partly solved the problem.

Certainly, the blackouts had now stopped and the set could withstand any amount of banging and thumping, but not with a perfect picture.

Banging the power supply board produced odd kinds of flickering lines on the screen. They were a mixture of black and white lines which went shivering up the screen, very much like tracking noise from a VCR. It was almost as though something was vibrating or ringing.

Some slow and gentle prodding soon had me able to produce the effect with the tiniest touch on the circuit board, near fuse F602. I was sure I had another dry joint, so I unsoldered the various leads on the top of the board and turned it over.

I paid particular attention to the area around the fuse holder, but there was nothing that looked like a dry joint. I decided to resolder the dozen or so joints on that part of the board but before I did so, I turned the board over and removed the fuse.

(I usually do this, as I once found solder wicking through the holder and soldering the fuse permanently into the clip. It's easier to flip the fuse out than to have to replace both fuse and holder.)

Anyway, as I grabbed the fuse I yelped and let it go in a hurry. Although I hadn't soldered anything yet, the fuse was hot enough to burn my fingers. Or at least, *one end* of it was hot. The other end was quite cold, which seemed to be a rather odd situation. I mean, both ends of the fuse should be carrying the same current and each should be equally hot!

I resoldered all the joints of interest, then turned the board over and reconnected all the other leads. Then I replaced the fuse and switched on, hoping rather fervently that this would be the end of the troubles.

But it wasn't to be. The set was just as touchy as before, except that the touchy area was now near the other end of the fuse. I wasn't sure if I had reversed the fuse when I replaced it, but without doubt the hot area was now the clip at the opposite end of the fuse holder.

Now we come to the climactic part of the story. Remember that all this time the picture has been shifting and shaking on the screen. The blackout and flickering lines were secondary faults, and the set was still going back to the owner with the shakes intact.

But one end hotter than the other is not the usual behaviour of tubular glass fuses, so I decided to change it for another fuse, to prove whether or not it was a fault in the fuse itself. I can't imagine what kind of fault it could be, because it checked normal to every test I could contrive — short of overloading it to see if it blew at the right current!

So a new 500mA fast-blow fuse was fitted. And the set fired up with a perfectly normal, flicker and *shake free* picture...

It would seem that for all that time, I had been chasing a component fault that could cause the shaking picture. It had been a faulty fuse in the power supply.

I don't know by what mechanism it caused the sideways movement of the picture, but from the time I fitted the new fuse the picture was rock steady.

I imagine that the fuse was upset-

(Continued on page 125)

Fault of the Month

Sanyo VCT5300 video recorder
SYMPTOM: Pronounced hum bars on all high band channels. The fault was barely visible on channel 2, but was so bad on high band VHF and UHF channels as to be quite unwatchable.
CURE: C5002, a 47uF 100V electro, was open circuit. This capacitor filters the output of the tuning voltage regulator and without it the tuner is fed with a wildly varying control voltage. (But this doesn't explain why channel 2 is so little affected.)
This information is supplied by courtesy of the Tasmanian Branch of The Electronic Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Silicon Valley NEWSLETTER

'Mac classic' sales booming

Apple computer appears to have scored an even bigger hit with its sub-US$1000 Macintosh Class than company officials had anticipated in their most optimistic sales forecasts.

The company said it is scrambling to keep up with demand and is rushing to double production of the system.

During November, Apple shipped about 30,000 Classics — more than Apple shipped of its MacPlus during the entire first year of shipments. Apple could have shipped nearly 50,000 machines if it had been able to produce them.

Shortages of the system will continue for several more months, Apple president Michael Spindler told reporters on the eve of the 7th annual MacWorld Expo in San Francisco.

Spindler said the company has also begun shipping the new Mac LC, a sub-US$2000 colour Macintosh. At the time the new Macs were launched, Apple said it wouldn't start shipping the LC until at least March due to a shortage of critical parts. But the softness in the overall semiconductor market has made the components more available, allowing the company to start shipping this month.

"Apple is finally doing what it needs to be doing — demonstrate that it can sell lots of machines while keeping the cost down," said PC Letter publisher Stewart Alsop.

Apple chairman John Sculley said he is particularly pleased with the sales results of the new Mac, as it is allowing Apple to regain some of the market share it has lost during the past two years. Most of the gains have come at the expense of PC clones, he added. "Everything we do over the next five years will be aimed at gaining marketshare."

Sculley said a majority of the new machines have been sold to people that did not own Apple computers before. In the past, Apple's sales have relied in large part on selling more advanced systems to the same customer base.

Apple Computer's new Mac LC, a sub US$2000 colour version of the Macintosh which the company began shipping in January. Encouraged by the success of its new Mac Classic model, Apple is expecting the LC to boost its sales in the education and business markets. An inexpensive coprocessor board will allow the machine to run Apple II software.

Spindler also said Apple is experimenting with infrared technology as a revolutionary new way to build computer networks. Spindler also said Apple hopes to have its new System 7.0 operating system ready by May.

Iraqis 'had benefit of US technology'

When US and other allied forces went into battle with Iraqi troops they brought with them some of the best technology the West had to offer — and so did the Iraqis.

Iraq, according to reports in the defence trade press has acquired considerable amounts of US and other Western defence technology and systems, during much of the 1980 when selling such systems was perfectly legal.

Now, a number of US high-tech firms are facing a considerable public relations problem in explaining why their equipment is lined up on the Iraqi side of the battle front.

Among the equipment Iraq has are:

- Minicomputers from Hewlett-Packard. The systems were sold to a German company in 1985 and '86, which was later described as having played a key role in Iraq's missile development program.
- Other systems were sold directly to Iraq. But a spokeswoman said annual sales to Iraq 'never exceeded US$5 million'.
- Microwave communications testers from Wiltron of Milpitas. The US$50,000 'scalar analysers' were sold in 1987 to the same Germany company that bought the HP computers. Both companies knew that Iraq was the ultimate buyer of the equipment.
- Satellite photo image analysers from International Imaging Systems (IIS) in Milpitas. The systems were sold between 1981 and 1987. They are used to analyse surveillance image data from satel-

lites and helped Iraq in its battles against Iran.

According to a Congressional committee that is investigating US-Iraqi business deals, there is no evidence that any firms broke US laws, and virtually all trade, including military has been halted since the August 2 invasion of Kuwait. IIS, for example, had permission from the Commerce Department to sell yet another of its imaging systems to Iraq this year. But the deal was never completed.

However, Ted Jacobs who is chief counsel to the House Committee on Commerce, Consumer & Monetary Affairs said US companies should have been more reluctant in accepting purchase orders from Iraq.

Under US laws, Iraq was supposed to state what it planned to do with the equipment it purchae.

"No one was willing to face up to what these products were going to be used for. There was an enormous amount of winking going on. You can't expect the Iraqis to send a letter saying: Dear USA. We want to make a ballistic missile," Jacobs said.

So far, no US company has been found to have sold Iraq equipment that could have aided that country in the development of its now destroyed chemical weapons operations. Instead systems sold to the Iraqis have been used mostly for missile development.

AMD reports big loss

The huge cost of lay-offs, plant closures, other cost-cutting moves and a big penalty in a patent infringement lawsuit, have cost Advanced Micro Devices to lose a whopping US$43 million during its past fourth quarter, bringing total 1990 losses to US$53.6 million. The company expects to report another loss for the current first period.

Not including the cost-cutting expenses, AMD lost $11 million on its operations. Most of the loss was caused by a $26 million penalty AMD had incurred after it lost a graphics chip patent infringement lawsuit that was brought by Brooktree.

Because of continued price pressures in AMD's major markets, the company's sales showed a disappointing 7% drop to $265.9 million.

For the year, AMD's sales totalled $1.06 billion, compared to $1.1 billion in 1989. That year AMD earned $46 million compared to the $53.6 million loss in 1990.

According to AMD chairman Jerry Sanders III, AMD will do better in the second half of 1991 as sales of the company's AM386 microprocessor will begin to bring in substantial sales and earnings.

AMD plans to officially launch the clone of the popular Intel 386 chip early this year. By year's end AMD hopes to have acquired a 10% share of the $1 billion 386 market. Last November, the company demonstrated the chip for the first time during the Comdex computer trade show in Las Vegas.

National Semi names new chief

In appointing Gilbert Amelio to replace Charlie Sporck as president of National Semiconductor when the latter retired in May, the Santa Clara company has recruited one of the few people in the industry qualified enough to fill Sporck's big shoes.

Amelio has been at the helm of Rockwell's electronics operations, which includes extensive semiconductor operations. He has also been chairman of the Semiconductor Industry Association.

Perhaps most important for National is that besides the necessary management skills to ensure a smooth transition, Amelio will bring the struggling chip maker a different set of skills that may well be a key in helping the company orchestrate some form of recovery.

Amelio holds a doctrate degree in solid state physics from the Georgia Instititue of Technology. "Amelio is no slough. He is respected as a good technologist," commented market analyst John Gerathy.

Amelio started his career at Bell Labs and holds no less than 10 patents for critical semiconductor technology inventions. Most notably, he is co-inventor of the world's first charge-coupled image sensor, a technology used commonly now in handheld video cameras.

After leaving Bell Labs, Amelio spent several years at Fairchild, including some as general manger of microprocessor operation. He joined Rockwell in 1988 and turned that company's money-losing communications group into a major profit centre for Rockwell.

National has long been in need of some 'fresh new blood,' and Amelio may well be the man to re-invigorate the firm. Changes, however, are likely to be gradual.

"I have no plans for immediate changes. It is not my style of management . I'll go in and learn the company and see what makes sense. We are going to focus on getting the job done and making the company financially and competitively successful," Amelio said.

Amelio said National chairman Peter Sprague, first contacted him about taking over from Sporck in October.

A-12 cancellation felt in valley

Silicon Valley depends heavily on the defence industry and is trying to absorb the latest blow to its prosperity: the cancellation of the A-12 'Stealth' Navy bomber program, which was cancelled in January by Secretary of Defense Richard Cheney.

Immediately, Kaiser Electronics, which was to produce advanced heads-up displays for the plane's cockpit, said it will lay off the 200 people involved in the project.

"We were notified to stop all work on the A-12 program, which involves a number of our people. Since we do not view this lack of work as a short-term problem, we must immediately reduce our workforce."

Cheney cancelled the program after concluding that the prime contractors, McDonnell-Douglas and General Dynamics would not be able to deliver the plane on time and within budget.

It is the largest military contract ever to be cancelled. In all, some 620 A-12 planes were to be built under a US$57 billion contract. Already, the Navy and its contractors have spent US$5 billion developing what would have become the Navy's primary aircraft carrier bomber for the next 30 years.

Cheney said the program had already fallen 18 months behind schedule and would have cost many billions of dollars more than anticipated. At a time of defence cuts, Cheney said he didn't think that Congress would have authorised the additional funds.

Although the brunt of the impact will be felt by the prime contractors and the more than 9000 people employed on the A-12 contract, many Silicon Valley firms will be equally hurt.

A large portion of the advanced electronics sub-systems are built in the Valley which has already felt the impact of two years of defence cuts . ■

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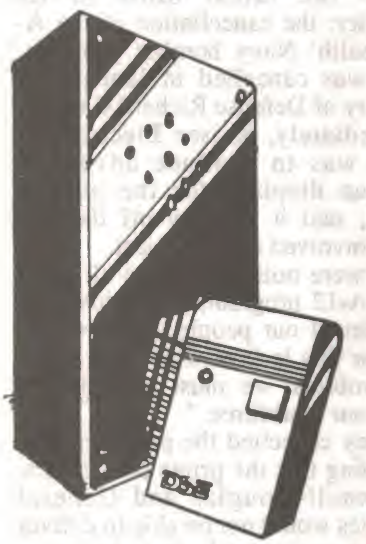

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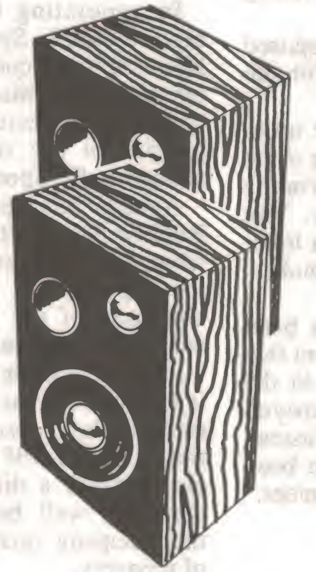

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Quality speaker kit to match Magnavox 15cm driver and 3AC tweeter. Kit includes cabinets, sleeves, baffles and all components for crossovers.

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6MV Woofer Speaker K-3999 (originally $29.95) — $19.95

3AC Tweeter Speaker K-3998 (originally $6.95) — $5.95

KITS	CAT NO.	PARTS VALUE	PRICE
Walkabout Wadio	K-2720	$30	$9.95
Motion Detector	K-2721	$35	$19.95
Tilt Alarm	K-3248	$7	$4.95
Battery Power Supply	K-3460	$60	$39.95
RF Probe (suits Bench Amp)	K-3470	$10	$4.95
Ni-Cad Fast Charger	K-3476	$100	$59.95
Sprinkler Timer	K-3588	$100	$59.95
Low Cost Amplifier (s/form)	K-4001	$180	$49.95
120W-150W Spkr Protector	K-4008	$40	$29.95
Brake Lamp Monitor	K-4500	$35	$19.95
Vehicle Exhaust Monitor	K-4610	$85	$49.95
30W Stereo Amplifier (s/form)	K-5100	$130	$99
UHF GasFet Preamp	K-6309	$80	$59.95
RF Attenuator	K-6323	$80	$49.95
80m Low Power Transmitter	K-6326	$40	$29.95
80m VFO to suit K-6326	K-6327	$30	$19.95
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3 Band Short Wave Radio	K-6355	$80	$49.95

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DICK SMITH ELECTRONICS

B1103/PB

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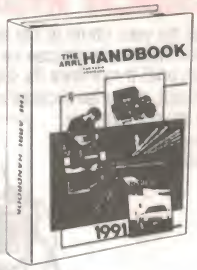

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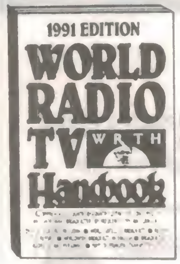

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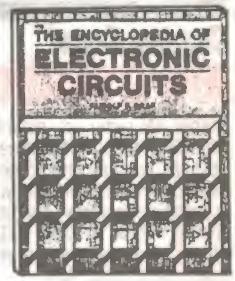

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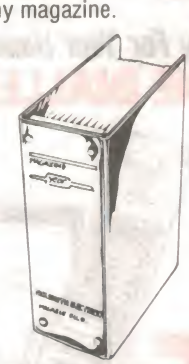

UP-TO-DATE WORLD TRANSISTOR COMPARISON TABLE

Gives a description and equivalents of every transistor known.

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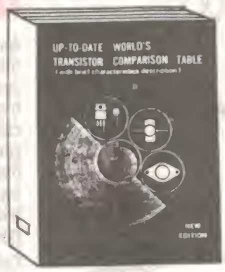

LINEAR IC EQUIVALENTS

Gives you descriptions, equivalents, and pin connections for linear ICs.

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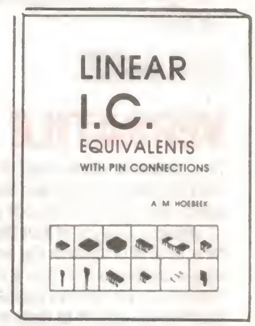

IDC GRADE CABLES

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1.2m x 1.6mm	W-4102	Colours	$2.50	$2.00
1.2m x 3.2mm	W-4104	Black	$2.95	$2.45
1.2m x 3.2mm	W-4106	Colours	$2.95	$2.45
1.2m x 4.8mm	W-4108	Black	$3.50	$3.00
1.2m x 4.8mm	W-4110	Colours	$3.50	$3.00
1.2m x 6.4mm	W-4112	Black	$3.95	$3.50
1.2m x 6.4mm	W-4114	Colours	$3.95	$3.50
1.2m x 9.5mm	W-4116	Black	$4.50	$4.00
1.2m x 9.5mm	W-4118	Colours	$4.50	$4.00
1.2m x 12.7mm	W-4120	Black	$4.95	$4.50
1.2m x 12.7mm	W-4122	Colours	$4.95	$4.50
1.2m X 19.1mm	W-4124	Black	$6.95	$6.25
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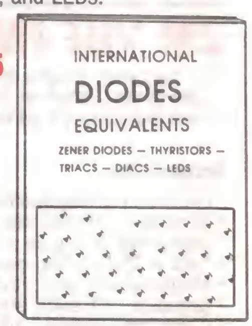

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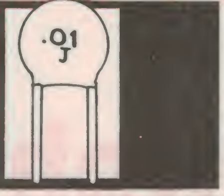

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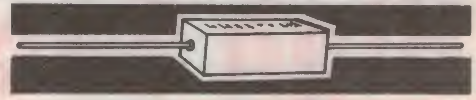

50V CERAMIC CAPACITORS

CAT NO.	pF	PRICE
R-2215	1	20c
R-2217	1.5	20c
R-2219	2.2	20c
R-2221	2.7	20c
R-2223	3.3	20c
R-2225	3.9	20c
R-2227	4.7	20c
R-2229	5.6	20c
R-2231	6.8	20c
R-2233	8.2	20c
R-2235	10	20c
R-2237	12	20c
R-2239	15	20c
R-2241	18	20c
R-2243	22	20c
R-2245	27	20c
R-2247	33	20c
R-2249	39	20c
R-2251	47	20c
R-2253	56	20c
R-2257	68	20c
R-2259	82	20c
R-2285	100	20c
R-2287	120	20c
R-2289	150	20c
R-2291	180	20c
R-2293	220	20c
R-2295	270	20c
R-2296	330	20c
R-2297	390	20c
R-2299	470	20c
R-2301	560	20c
R-2303	680	20c
R-2305	820	20c
R-2307	1000	20c
R-2309	2200	20c
R-2311	3300	20c
R-2313	4700	20c
R-2315	5600	20c
R-2317	6800	20c
R-2319	8200	20c
R-2321	0.01uF	20c
R-2323	0.022uF	20c
R-2325	0.033uF	20c
R-2327	0.047uF	20c

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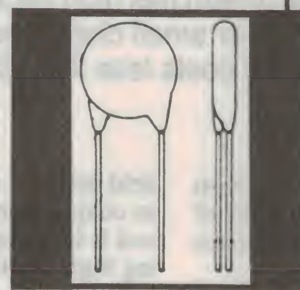
R-2378	150	$1.55	$0.75
R-2380	180	$1.55	$0.75
R-2381	220	$1.55	$0.75
R-2382	270	$1.55	$0.75
R-2383	320	$1.55	$0.75
R-2384	390	$1.75	$0.85
R-2386	470	$1.75	$0.85
R-2387	560	$1.85	$0.90
R-2388	680	$1.85	$0.90
R-2389	820	$1.95	$0.95
R-2390	1000	$1.95	$0.95
R-2392	2200	$1.65	$0.80
R-2393	3300	$1.85	$0.90
R-2394	4700	$2.05	$1.00
R-2395	5600	$2.25	$1.10
R-2396	6800	$2.45	$1.20
R-2398	8200	$2.65	$1.30
R-2400	10000	$2.85	$1.40



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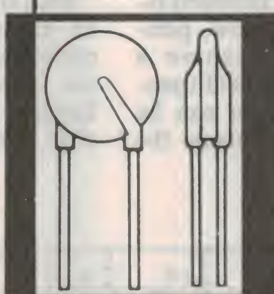

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CAT NO.	mA	PRICE	10 UP PRICE
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R-1787	0.7	$8.95	$4.45
R-1788	0.9	$9.95	$4.45
R-1789	1.15	$9.95	$4.45
R-1790	1.35	$10.95	$5.45
R-1791	1.85	$10.95	$5.45
R-1792	2.45	$11.95	$5.45
R-1793	3.05	$12.95	$6.45
R-1794	3.9	$14.95	$7.45

5W WIRE WOUND RESISTORS

Cat No.	Ohms	Price
R-1600	0.1	65c
R-1603	0.22	65c
R-1601	0.47	65c
R-1602	1	65c
R-1604	1.2	65c
R-1606	1.5	65c
R-1610	2.2	65c
R-1614	3.3	65c
R-1618	4.7	65c
R-1620	5.6	65c
R-1622	6.8	65c
R-1624	8.2	65c
R-1626	10	65c
R-1628	12	65c
R-1630	15	65c
R-1632	18	65c
R-1634	22	65c
R-1636	27	65c
R-1638	33	65c
R-1640	39	65c
R-1642	47	65c
R-1644	56	65c
R-1646	68	65c
R-1648	82	65c
R-1650	100	65c
R-1652	120	65c
R-1654	150	65c
R-1656	180	65c
R-1658	220	65c
R-1660	270	65c
R-1662	330	65c
R-1664	390	65c
R-1666	470	65c
R-1668	560	65c
R-1670	680	65c
R-1672	820	65c
R-1674	1k	65c
R-1676	1.2k	65c
R-1678	1.5k	65c
R-1680	1.8k	65c
R-1682	2.2k	65c
R-1684	2.7k	65c
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YOUR EIGHT SPECIALTY STORES IN ONE

Construction Project:

High Security IR Remote Control Switch

A solid state key is a reality with this high security infrared switch. It boasts over half a million codes and because it operates over small distances only, no one could possibly break the code. It's also very easy to construct, and costs less than $50 for a complete kit.

by ROBERT PRIESTLEY

Mention remote control and most people think of a system capable of operating over a distance of 10 metres or more.

However it is often unnecessary to have such a range, particularly for applications such as unlocking a door, arming or disarming an alarm, or operating a key controlled device.

If an actual key is being used, the distance is limited to arm's length, for obvious reasons. If the key is an electronic device, having it capable of operating some distance away from the 'lock' is inviting poor security and unless it is a garage door or the like, no real advantage is obtained.

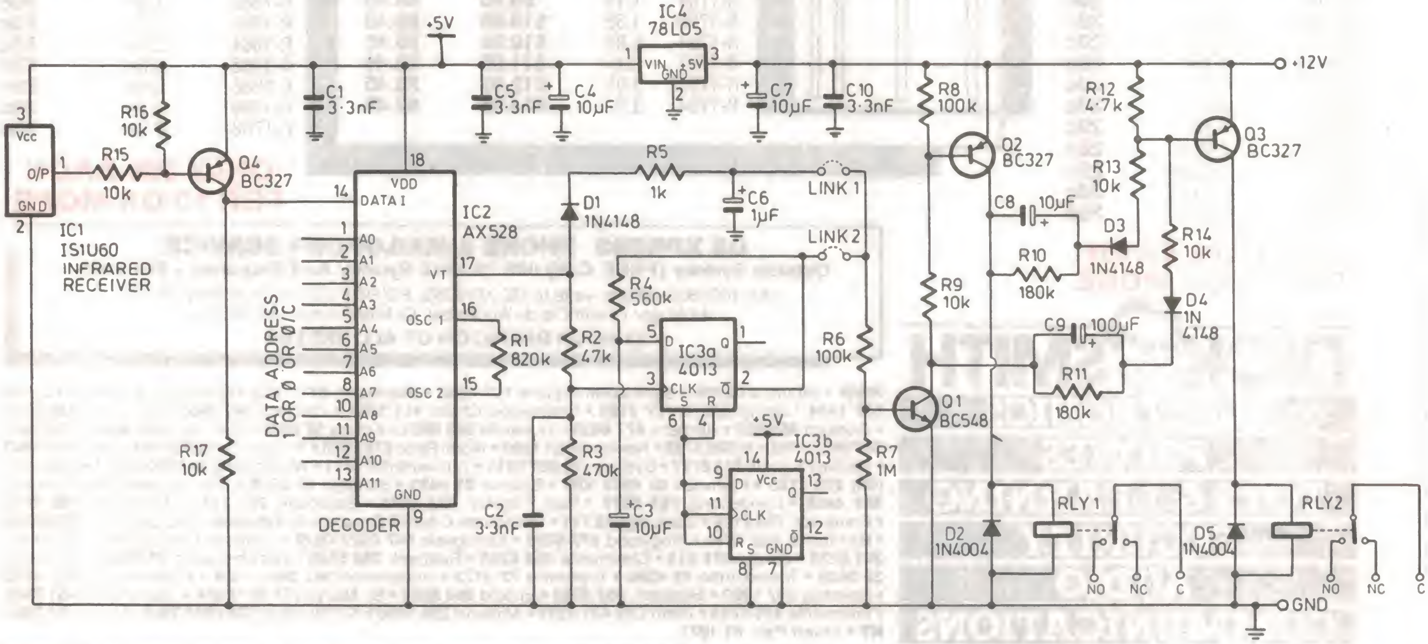
This project uses a miniature hand-held infrared transmitter that operates in conjunction with a receiver module and is intended for applications requiring high security.

For this reason, it has been purposely designed to operate over distances of around 500mm or so — but with the advantage that it can operate through glass.

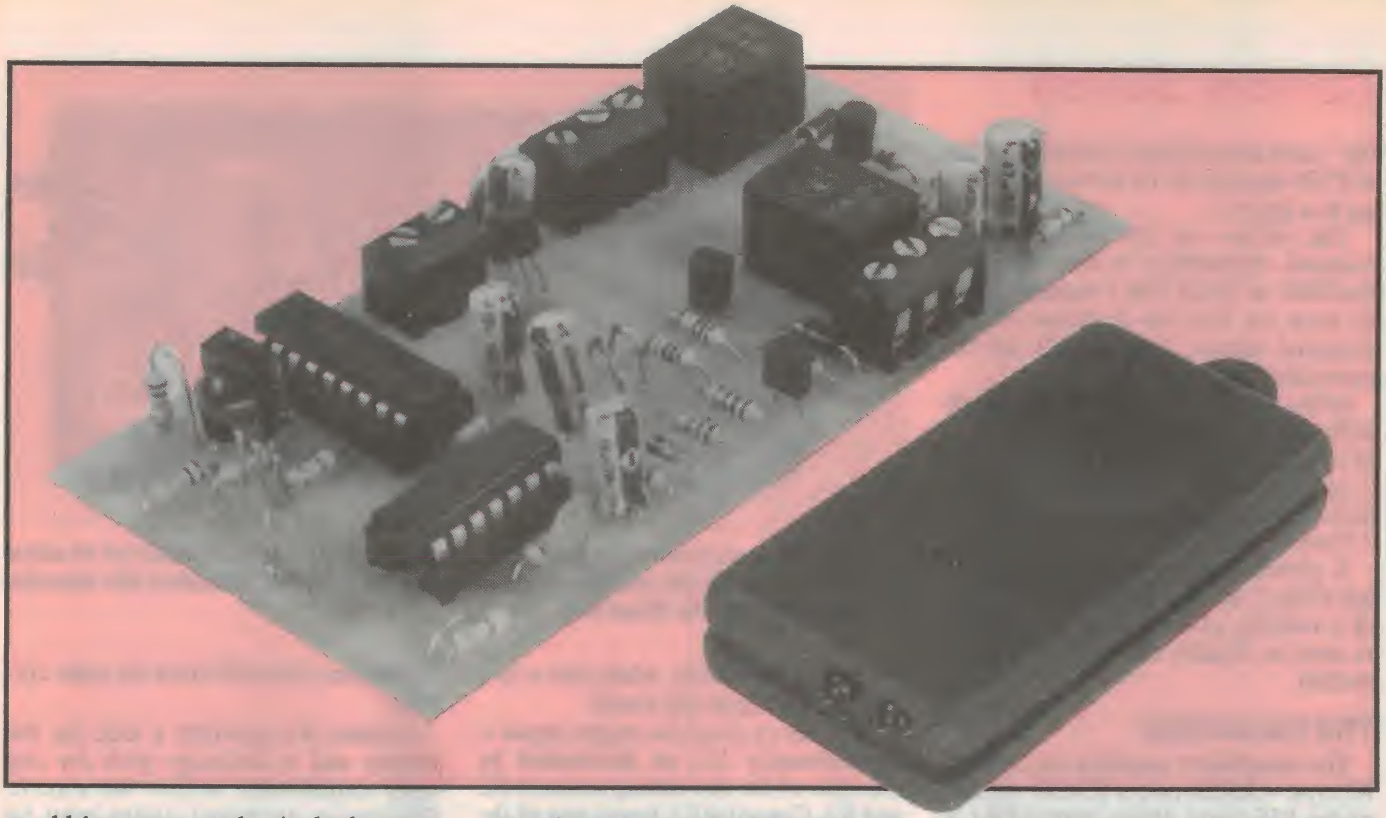
For example, you might want to arm and disarm your car alarm using this project. In this instance, the infrared receiving device would be mounted inside the car behind a window, positioned so that it can receive a transmission from the hand-held transmitter. This way, the alarm can be armed or disarmed from outside the car, with some form of indicator mounted near the receiver so that the status of the alarm is shown. A great way to prevent those embarrassing false alarms!

Because of the inherent high security of this project, it can also be used in place of a mechanical lock and key, in which the transmitter and receiver represent the 'key', with an electrically operated lock being controlled by the receiver.

As a front door key, a receiver could be mounted discreetly to drive an electric door lock and each member of the family could have a transmitter. Because there are over 500,000 possible codes, it's unlikely anyone else



The circuit diagram of the receiver is shown above. The infrared signal from the transmitter is detected, amplified and demodulated by IC1 and then inverted by Q4 before being fed to the trinary decoder IC2. The links set the mode of operation for relay 1 to either on-off or toggle.



would have your code. And when you consider the cost of the transmitter is less than $18.00, having a number of them is about as expensive as having the same number of keys.

The details

As the various photos show, the project consists of a small infrared transmitter fitted in a commercial quality case and a receiver module mounted on a PCB.

Being infrared, there is no tuning required for either the transmitter or the receiver. The receiver is mounted on its own PCB, and two relays are provided on the board to drive indicator lamps and other hardware.

A feature of the design is the facility to select either on-off or toggle mode. This is set by a link on the board, and when the receiver is configured to on-off mode, it will operate the relays only while the transmitter button is pressed. This mode of operation would suit an electric door lock.

The toggle mode would be used to arm or disarm an alarm, in which the receiver relay is turned on by pressing the transmitter button. When the transmitter button is pressed a second time, the relay will turn off. The transmitter is powered by a 6V alkaline cell and an external power supply of 12V is used to power the receiver.

As already mentioned, the receiver has two relays mounted on the board, one to drive external hardware and another to drive indicator lamps.

But the real strength of the project is provided by the all-new trinary encoder and decoder ICs.

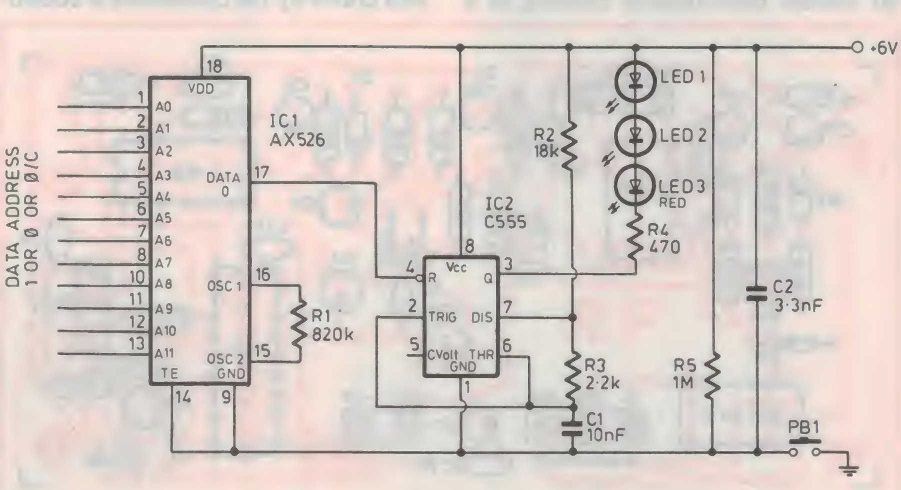
While these types of ICs have been around for a while, those used in this project are the latest and have a number of features that make them easier to use.

Basic operation

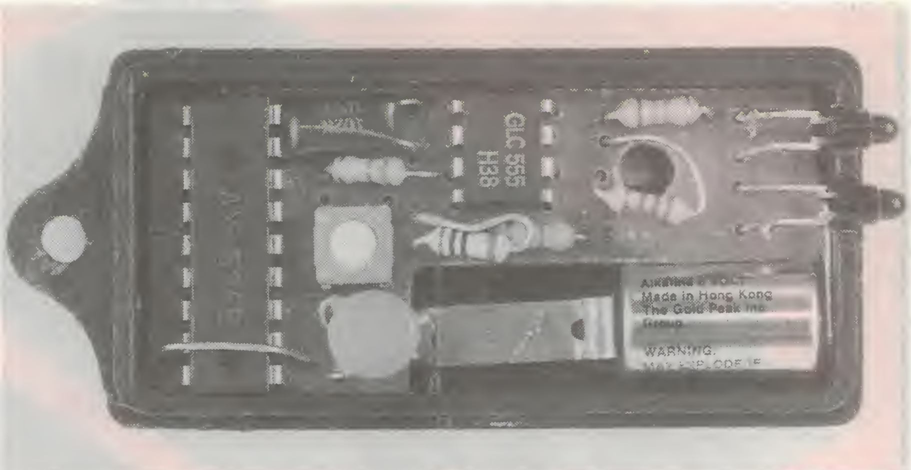
When the transmitter button is pressed, the transmitter sends out a digital pulse train modulated on a carrier of 38kHz. At the same time, a LED indicator pulses to show that a signal is being transmitted.

Two infrared LEDs are used to produce the output signal and the range is limited to less than one metre. However, it is possible to increase the output signal level by adding an output stage to the transmitter, as will be described later in this article.

The front end of the receiver board is designed around a three terminal OPIC (OPtical Integrated Circuit) sensor. This device incorporates a lens, photodiode, amplifier, bandpass filter, detector, automatic gain control and output buffer amplifier. Quite a fancy device in fact, and the output from the OPIC is a demodulated digital signal identical to that transmitted. If the demodulated digital code is correct,



The circuit diagram of the transmitter, in which an AX526 trinary encoder outputs a code determined by the setting of the address lines. This code is used to gate the 38kHz oscillator around IC2, which drives the infrared diodes.



This shot shows the transmitter PCB. Several components are laid flat to allow the board to fit inside the case. The only link on the PCB straddles the encoder IC, requiring it to be fitted last.

the 'valid transmission' terminal of the AX528 decoder IC on the receiver will go to a logic 1.

The relays on the receiver will respond, depending on the setting of the links in which link 1 causes relay 1 to turn on for the duration of the received signal. Link 2 will set the operation to toggle mode.

Relay 2 can be used to switch an indicator to show the status of relay 1, in which a long duration pulse by relay 2 indicates relay 1 is now turned on, and a short duration pulse shows relay 1 is now turned off.

A possible application might be to use relay 2 to switch the blinker lights of a vehicle, where this project is used to arm or disarm the vehicle's alarm system.

The transmitter

The transmitter contains an encoder IC type AX526, and a CMOS version of the 555 timer. When button PB1 is pressed, power is applied to the circuit and the trinary encoder IC1 produces a serial digital output code at pin 17.

The code depends on the connections applied to the twelve address pins, (A0-A11) and the pulse width is determined by timing resistor R1.

Each address pin can be either a logic 0, logic 1 or an open-circuit, giving 532,441 possible codes, (3^{12}). The value of the timing resistor can also be changed, so the number of possible codes can therefore be extended by changing the width of the pulses.

The data output of IC1 is used to gate IC2 via its reset terminal. This IC is a 555 timer (CMOS), configured as an astable multivibrator running at a frequency of 38kHz; when pin 4 is a logic 1, an output will result.

The duty cycle of the output signal is approximately 1:9, as determined by the ratio of the two timing resistors R3 and R2. Capacitor C1 forms part of the timing network, along with R2 and R3.

When output pin 3 of IC2 switches low, current flows through the two infrared diodes producing a transmission. Thus a logic 1 from IC1 is transmitted as a series of 38kHz pulses that last for the duration of the pulse applied to pin 4 of IC2. LED L3 is included to provide visual confirmation that the transmitter is functioning.

The current flowing in the LEDs is limited by R4, and if its value is reduced, more current can flow through the LEDs — thus increasing the range of the transmitter at the expense of battery life. Because a duty cycle of 1:9 is used, the average current drawn by the transmitter is considerably less (Ipeak/9) than the peak current.

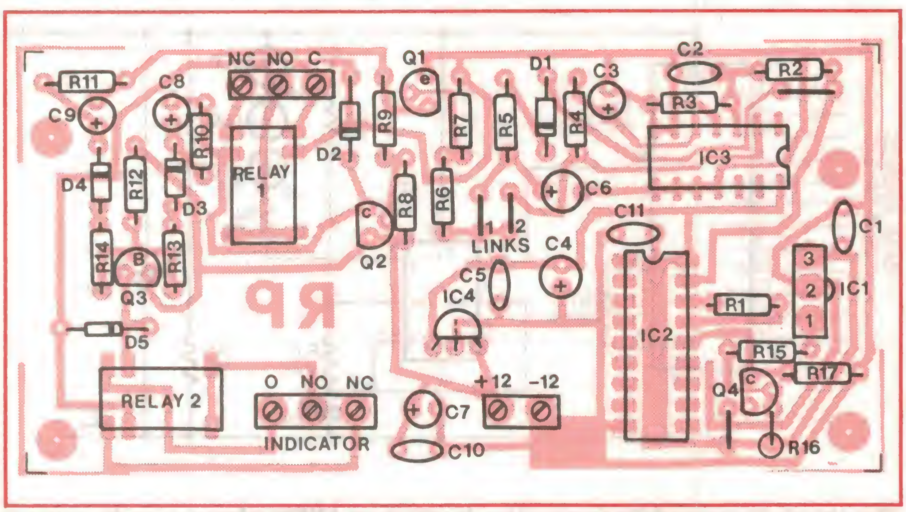
Resistor R5 provides a load for the battery and a discharge path for any stray capacitance within the circuit. Otherwise, incorrect codes may be produced by the encoder. Capacitor C2 bypasses noise that might be developed on the supply lines.

The receiver

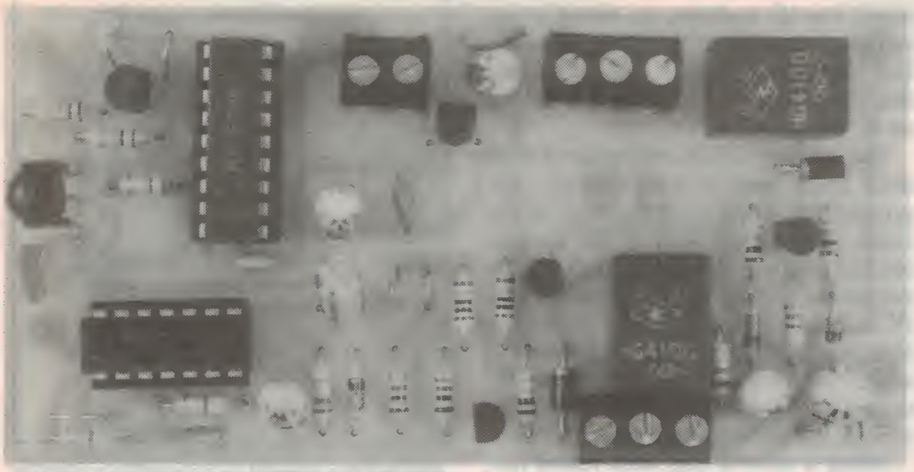
The incoming infrared light is picked up by IC1, an OPIC infrared sensor type IS1U60. This IC amplifies and demodulates the incoming signal and produces a digital output at pin 1. Because the OPIC sensor uses negative logic its output has to be inverted; this is achieved by Q4 and its associated resistors, R15, R16 and R17.

The inverted signal appears across R17 and is applied to the 'Data In' terminal of IC2 at pin 14. If the received code matches the code applied to the address pins of IC2, the Valid Transmission terminal (pin 17) will be set to a logic 1. The code setting for IC2 must (obviously) match that for the encoder in the transmitter, and the same rules apply, in which address lines A0 to A11 are connected to either a logic 0, logic 1 or left open-circuit. The value of the timing resistor R1 must also be the same as the timing resistor in the transmitter.

From here on, the operation of the circuit depends on the setting of the links, link 1 and link 2. If link 1 is connected and link 2 is left open the operation is as follows. When a valid transmission is detected, pin 17 of IC2 goes high, causing a positive voltage to occur at the base of Q1, via isolating diode D1 and resistors R5 and R6.



This diagram shows the layout of the receiver PCB. The 12V supply for the PCB is connected to the terminal block at the bottom left of the board.



The receiver PCB is shown in this photo. The OPIC is orientated with the lens facing outwards from the board and the two links in the centre of the board set the mode of operation.

Thus, Q1 will turn on. The combination of D1, R5 and capacitor C6 will hold Q1 on for a short time, in case there is a loss of signal during operation of the transmitter. When Q1 turns on, Q2 is also turned on as current can flow through its base-emitter junction. Q2 is used to switch relay 1, and this relay will remain on for as long as a valid transmission condition exists.

Relay 2 is the indicator relay, driven by Q3. When Q1 turns on, it will connect C9 to ground, allowing it to charge via the base-emitter junction of Q3, R14 and D4. While C9 charges, Q3 will turn on, energising relay 2. When C3 is fully charged, there will be insufficient current to hold Q3 on, and it will then turn off, switching off relay 2. Thus, relay 2 will turn on for a time determined by the values of R12, R14 and C9.

When transmission ceases, Q1 will turn off, turning off Q2 and relay 1 as well. This time, C8 is pulled to ground via the relay coil, causing it to charge towards the positive rail via the base-emitter junction of Q3, R12 and R13. This will cause Q3 to turn on again, until C8 is fully charged.

Because the value of the timing capacitors C8 and C9 are different, Q3 will be on for a longer time interval when a transmission is first detected, compared to the time interval when transmission ceases. Thus relay 2 can be used to switch an indicator (buzzer, light or similar) in which a long pulse shows 'transmission started' and a short pulse shows 'transmission ceased.'

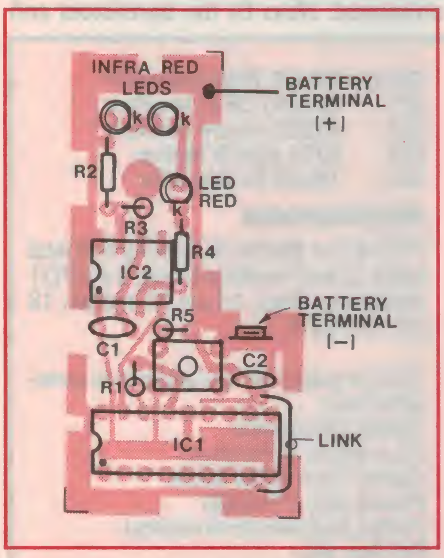
If a LED indicator is used in this application, it could be operated directly by Q3, where the LED is connected in place of relay 2 (with a suitable series resistor).

By including the relay, a wide range of indicating devices can be switched — such as blinker lights in a vehicle. The time intervals can be altered by changing the values of C8 and C9.

If link 2 is connected and link 1 is removed, the operation of the circuit is altered to toggle mode, as the type D flipflop of IC3 is now included. This IC is configured as a T-type flipflop by connecting its Q-bar output to the D input, via R4. Thus when a positive pulse occurs at the clock input (pin 3), the output state of pin 2 (Q-bar output) will change. Resistor R4 and capacitor C3 form a time constant of around half a second to prevent false toggling of IC3. The output of IC3 is connected (via link 2) to the rest of the circuit which operates as already described. Thus, when a valid transmission is first detected, the Q-bar output of IC3 will toggle to a logic 1, switching Q1 and Q2 on. Q3 will also switch via C9 as before. However this time Q1 and Q2 will be held on when the transmission ceases, as IC3 will not change state until the next transmission.

When this occurs, the output of IC3 will toggle to a logic 0, turning off Q1 and Q2. Thus relay 1 will switch off and relay 2 will pulse on again as a result of C8 charging. In other words, the operation of relay 2 is identical for both on-off and toggle modes, while relay 1 is controlled differently for both modes.

Diodes D2 and D5 are used to protect the switching transistors from



This layout diagram of the transmitter should be studied in conjunction with the photo of the transmitter PCB to see how the various components are arranged so the PCB can fit inside the case.

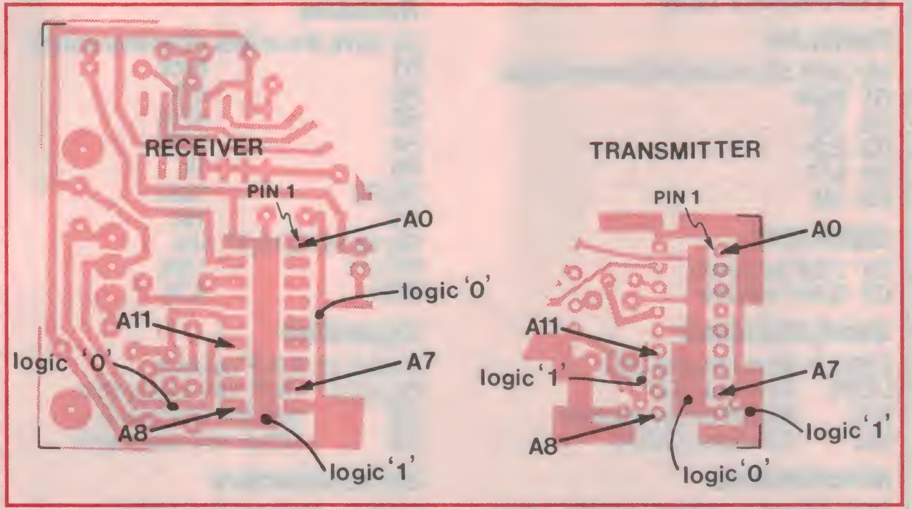


Fig.1: This diagram shows how to code the trinary encoder and decoder ICs. Use wire links to connect the selected address pins to either a logic 1 or a logic 0. An open-circuit is also a valid code.

the back-EMF generated in the relay coils as they switch off. Supply decoupling is provided by C1, C4, C5, C7 and C10. The 5V regulator IC4 is required as IC1 has a maximum supply voltage of 6 volts. This regulator also supplies IC2 and IC3, while the rest of the circuit is powered directly from the incoming 12V supply.

Construction

Construction of the complete project is relatively straightforward, with the parts accommodated on two small PC boards. As already described, the encoder (IC1) on the transmitter PCB and the decoder (IC2) on the receiver need to be coded by connecting their address lines to either a logic 1, logic 0 or left open-circuit.

The PCBs are supplied with all the address lines for both ICs open-circuited, and we recommend that coding be applied after the unit has been fully tested. The initial code will therefore be all address lines open-circuit.

Transmitter assembly

The transmitter PCB needs to fit inside a very small case, requiring some components to be laid horizontally. Refer to the layout diagram and to the photo of the transmitter PCB to see how the components are mounted.

Start by fitting the resistors and capacitors, then solder the ICs in place. As both these ICs are CMOS, be sure you earth yourself and the soldering iron before soldering them. There is no room for IC sockets, so the ICs are soldered directly to the PCB. Note the link that straddles IC1 and make sure that once fitted, the link is not touching an IC pin.

The infrared LEDs are mounted with their leads bent at a right angle, approximately 6mm from the body of the LED. The anode lead is the longest lead of the two. When fitting the push-button switch, mount it 1mm above the PCB board and use some electrical tape placed under the top of the case to adjust the sensitivity of the button. The case also needs to be filed to accommodate the protruding infrared LEDs.

Using a smooth cut 3mm round file, file two semi-circles in the front lip of both halves of the case located so the LEDs can fit into the holes. Alternatively, a soldering iron can be used to 'burn' the holes into the plastic, with excess plastic pared away with a sharp knife. Just be careful not to burn too much plastic away, and clean the tip of the iron after this operation.

The case was designed for a 9V alkaline battery rather than the 6V type being used, and the battery holder molded inside the bottom of the case will have to be cut away with side cutters. Again take care not to crack the plastic. The battery contacts are soldered to the PCB and should be formed from strips of phosphor bronze or similar.

The photo of the transmitter shows the arrangement required, in which the negative connection is extended towards the battery and the positive connection is aligned to the end of the PCB. Form a right angle at the end of the strip forming the negative connection, to give tension against the battery. Once construction is completed, test the unit by confirming that the red LED indicator operates when the button is pressed. If not, check the polarity of the infrared LEDs in case they have been fitted the wrong way round.

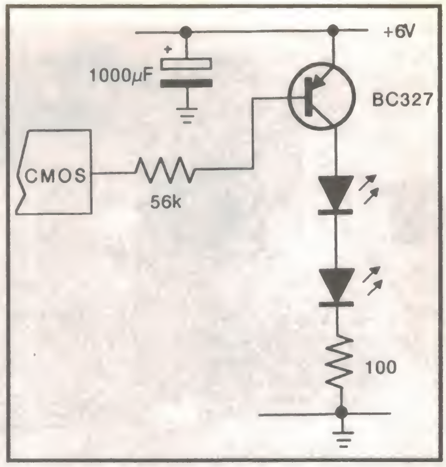


Fig.2: This circuit or something similar can be used to increase the power output of the transmitter, and therefore its range. This circuit has not been tested, so the values migh need to be modified.

Receiver assembly

Commence assembly of the receiver PCB by fitting the two fixed links and the low profile components.

Make sure the six electrolytic capacitors and five diodes are correctly orientated. Next fit the transistors and

PARTS LIST: TRANSMITTER

Resistors

All 1/4W, 5% unless otherwise stated:

R1	820k
R2	18k
R3	2.2k
R4	470
R5	1M

Capacitors

C1	10nF polyester
C2	3.3nF ceramic

Semiconductors

LED1,2	3mm infrared LED
LED3	3mm red LED
IC1	AX526 trinary encoder
IC2	555 timer, CMOS

Miscellaneous

PCB 52mm x 24mm; plastic case; miniature push button switch, 6V alkaline battery.

PARTS LIST: RECEIVER

Resistors

All 1/4W, 5% unless otherwise stated:

R1	820k
R2	47k
R3	470k
R4	560k
R5	1k
R6,R8	100k
R7	1M
R9,13,14,15,16,17	10k
R10,11	180k
R12	4.7k

Capacitors

C1,2,5,10	3.3nF ceramic
C3,4,7,8	10uF, 16V electrolytic
C6	1uF 35V electrolytic
C9	100uF 16V electrolytic

Semiconductors

D1,3,4	1N4148 signal diode
D2,5	1N4004 1A diode
Q1	BC548 NPN transistor
Q2,3,4	BC327 PNP transistor
IC1	IS1U60 OPIC receiver
IC2	AX528 trinary decoder
IC3	4013 dual D flipflop
IC4	78L05 5V regulator

Miscellaneous

PCB 105 x 53mm; 2 x 3 way terminal block; 2 way terminal block; 2 x SPDT miniature relays; 14 pin IC socket; 18 pin IC socket.

A kit of parts for this project is available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West NSW 2223.
Phone (02) 579 4985
Postal Address (mail orders)
PO Box 89,
Oatley NSW 2223.
Prices:
Transmitter $17.90
Receiver $29.90
Postage & Packaging $ 2.50

the voltage regulator IC4. This IC looks the same as the transistors, so be sure you have the right device before soldering it in. Then fit the IC sockets, the relays and the terminal blocks.

Now decide which mode of operation you want for the relays and fit the appropriate wire link, where link 1 sets the unit for on- off mode and link 2 gives toggle mode.

The OPIC (IC1) can now be fitted, taking care not to apply too much heat when soldering. Note that the lens faces outwards from the PCB.

Testing and coding

Final testing involves powering up the receiver board using a 12V DC supply, connected to the terminal block as shown on the layout diagram. When power is initially applied the relays should pulse. Then point the transmitter at the infrared sensor and check that the relays energise according to the selected mode.

If everything works correctly, the code you wish to use can now be applied. Fig.1 shows details of the coding and which tracks represent a logic 0 (ground) or a logic 1 (+5V rail). Note that the ICs have the same pin connections for their address lines, so the connections you use should look the same for both ICs.

Solder short pieces of wire between the appropriate address lines and the required logic level. Remember that a pin can also be left in the open-circuit condition to form part of the code. Check to see that the unit still functions after coding, and if necessary remedy any errors.

If the unit still doesn't work, remove the coding on both ICs to restore it to all open-circuit and proceed to fault find the circuit.

Modifications

The OPIC sensor on the receiver board can be mounted externally from the receiver board. This would be the case if the unit was being used with a car alarm, where the sensor might be placed on the inside of the driver's window, so that the transmitter could be aimed through the window at the sensor. To do this, use screened two-pair cable, where the two inner conductors are used for the +5V supply (pin 3) and data out (pin 1), and the outer screen is used as the ground connection (pin 2).

If the OPIC sensor is going to be mounted so it is directly exposed to the sun, then we suggest fitting it inside a piece of black tubing to help reduce infrared interference from the sun. This will also help protect the device and make it less obvious.

As already mentioned, a LED indicator can be used in place of relay 2 to give the long-short indication previously described. Solder a 1k resistor in series with the LED, and fit the LED and resistor combination in place of relay 2. The anode of the LED should connect to the collector of Q3.

To increase the range of the transmitter, a driver circuit for the infrared LEDs such as that shown in Fig.2 could be used. This circuit has not been tested, so the values may need to be trimmed to give the best operation.

The value of the series resistor will allow approximately 20mA of current to flow in the diodes for a 6V supply.

The 1000uF capacitor acts a reservoir to supply current bursts to the circuit when the transistor is switched by the output of the 555 timer. Naturally this circuit won't fit inside the transmitter case.

And perhaps you might think of other variations for this project, or put it to uses we haven't thought of. Just remember to use a suitable code, and don't simply leave the code as all open-circuit. ■

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(See SC Oct '88)

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(See SC Feb '88)

This project will sense a door opening in a large or small room and will sound a two-tone chime. It does not have to be anywhere near the doorway as it uses an ingenious sensor to detect the pressure change caused when the door opens.

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Get that atmosphere of tranquility that only birds can give. The realism of this project is remarkable. Sounds for all the world like two trilling canaries.

- Saves the mess of birds
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- Easy to build

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(See SC Dec '87)

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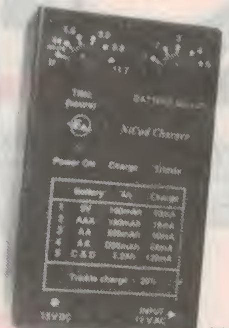
K 3255 ~~$59.00~~ $49.00

Automatic Charger for NiCads (See EA July '89)



Get 100's more recharge cycles from your nicads.

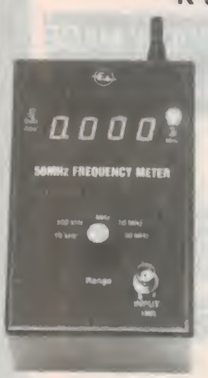
Its now well known that correctly charging nicad cells greatly extends their service life.

Here is a fully automatic NiCad battery charger that enables differing charge rates as appropriate for AAA, AA, C, D cells or cells in series up to 9V. Once the battery is charged, the unit automatically switches to trickle charge until you switch it off. It is fully featured, yet surprisingly simple.

K 1650

~~$39.50~~ $29.95

50MHz Digital Frequency Meter



(See EA May '88)

Easy to build & construct this fantasic meter measures to well over 50MHz in 5 ranges. Features high input impedance, overflow LED indicator, KHz & MHz LED indicators. All componenets mount onto single PCB, even the selector switch.

K 2510 ~~$99.00~~ $89.00

Telephone Off Hook Indicator

Use where 2 or 3 phones are connected on one line. If one extension is in use a LED will flash in each of the other extensions. Requires no external supply.

K 1400 $9.95

Speech Synthesizer

Here is a self contained Speech Synthesizer that does not require a computer to control it.

(ETI March '88)

This small, simple circuit contains all the necessary components to make your favourite possessions speak. It can be connected to almost any appliance, vehicle or home remote control system to let you know when the kettle has switched off, the doors are locked or the water in the radiator is boiling. The inputs are coded and priority message reading means warnings are heard instead of greetings etc if two messages are sent at the same time. Blank Eprom included to allow you to program the messages you want.

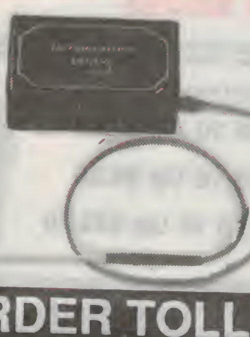
K 9500 ~~$95.00~~ $89.00

K 9502 Pre-Programmed Eprom for K 9500 $20.00

Low Cost Temperature Probe

Here's an easy to build probe which adapts a multimeter or electronic voltmeter into a general purpose thermometer. It's just the shot for measuring heatsink temperatures, how hot it gets inside your car, or where little Johnny has a fever!

Measurers accurately from - 20 deg.C to =120 deg.C.



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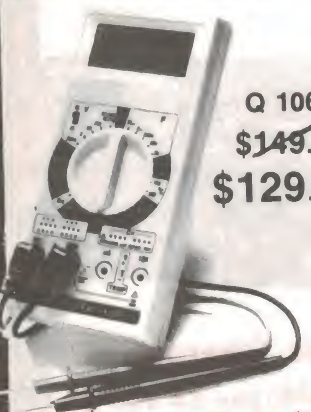

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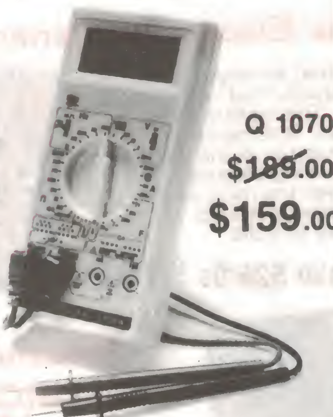

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Input Impedance: 10M Ohm
AC Voltage Range: 200mV, 2V, 20V, 200V, 750V
Input Impedance: 10M Ohm
DC Current Range: 200uA, 2mA, 20mA, 200mA, 10A
AC Current Range: 200uA, 2mA, 200mA, 10A
Resistance Range: 200Ohm, 2k Ohm, 20k Ohm, 200k Ohm, 2M Ohm, 20M Ohm, 2000M Ohm
Capacitance Range: 2000pF, 20nF, 200nF, 2uF, 20uF
Translstor hFE Base DC Current: 10uA, **VCE:** 2.8 +/- 0.4V
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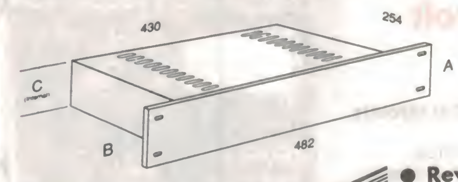

Side Elevation:
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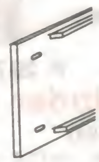

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Cat No.	Unit Height	A	B	C	Finish	Ea.	5 Up
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H 5012	2U	88	76	79	Raw Alum.	78.95	76.95
H 5013	3U	132	54	122	Raw Alum.	82.95	80.95
H 5021	1U	44	32	38	Nat Anod.	65.95	63.95
H 5022	2U	88	76	79	Nat Anod.	82.95	80.95
H 5023	3U	132	54	122	Nat Anod.	89.95	87.95
H 5031	1U	44	32	38	Blk Anod.	65.95	63.95
H 5032	2U	88	76	79	Blk Anod.	82.95	80.95
H 5033	3U	132	54	122	Blk Anod.	89.95	87.95

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H 6113	3U	Raw Alum.	25.95	24.95
H 5121	1U	Nat Anod.	12.95	11.95
H 5122	2U	Nat Anod.	20.95	19.95
H 5123	3U	Nat Anod.	27.95	26.95
H 5131	1U	Blk Anod.	13.95	12.95
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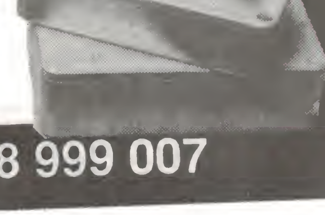

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The main control receiver runs on 240V AC with a 12V 1.2AH battery for emergency backup. All other units with the excepion of the line carrier, run on a 9V battery each. The average life expectancy is approximately one year. System works around 305MHz frequency where there is less chance of false alarm. The range of the unit is normally 80 metres in open space.

Main Control Receiver

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One S 5270	Reed Switch	S 5260 ~~$599.00~~
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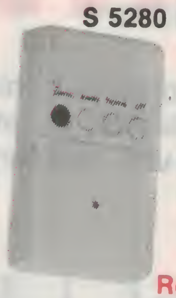

Keep it at the bedside table — allows you to arm the house perimeters when you retire or you can take it with you when you go out, arming your system after you lock the door.

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Construction Project:

A NEW 2M FM TRANSCEIVER - 4

Here we are at last, at the last phase of building this impressive new design. With all of the previously described sections assembled and tested, you should now be ready to for wiring up the last three sections necessary to complete the unit, and carry out final testing.

by JIM ROWE

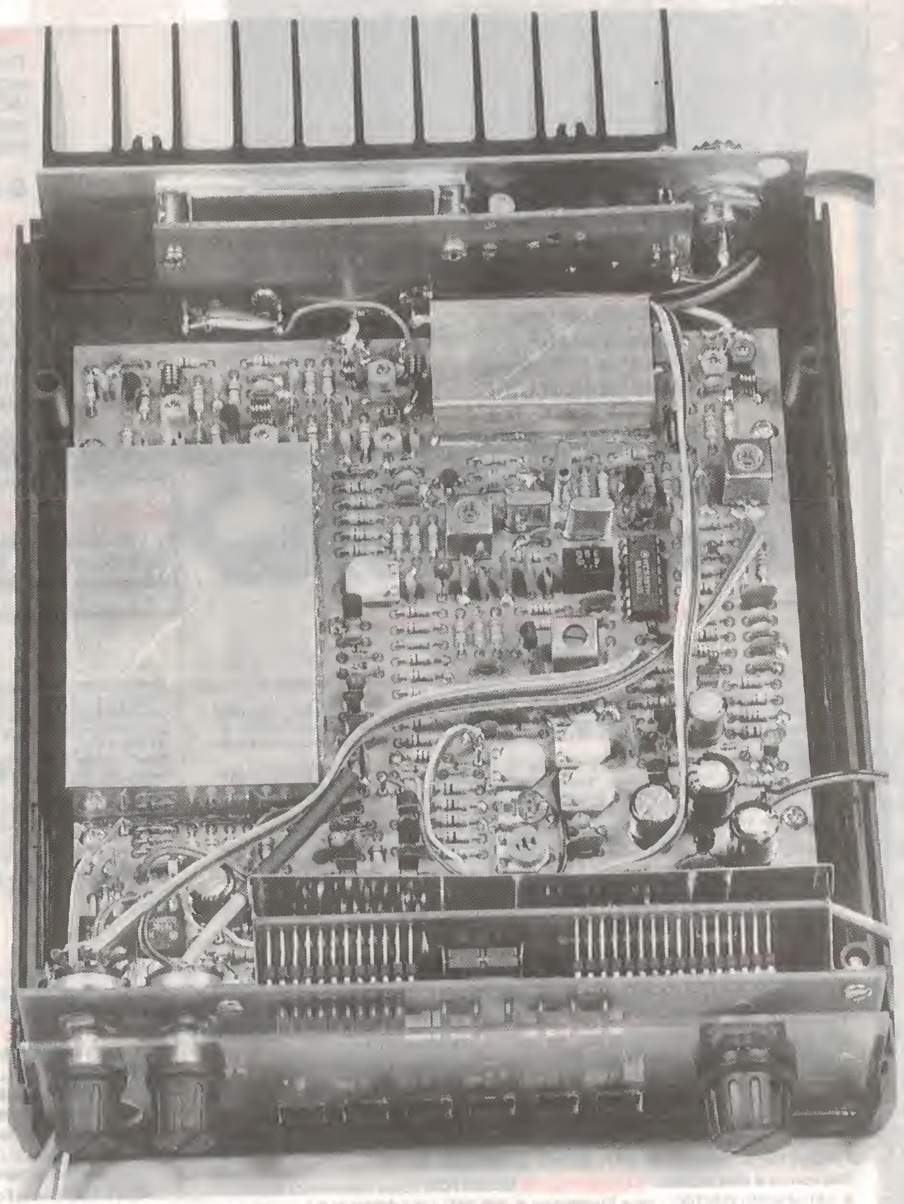
By now the 'receive' side of your transceiver should hopefully be functional, so that you've been able to listen into the 2m FM channels in your area, while waiting for this final installment. But no doubt hearing other amateurs making contacts has whetted your appetite to 'get going' fully yourself, so let's continue with the construction without further delay:

9. MIC PREAMP

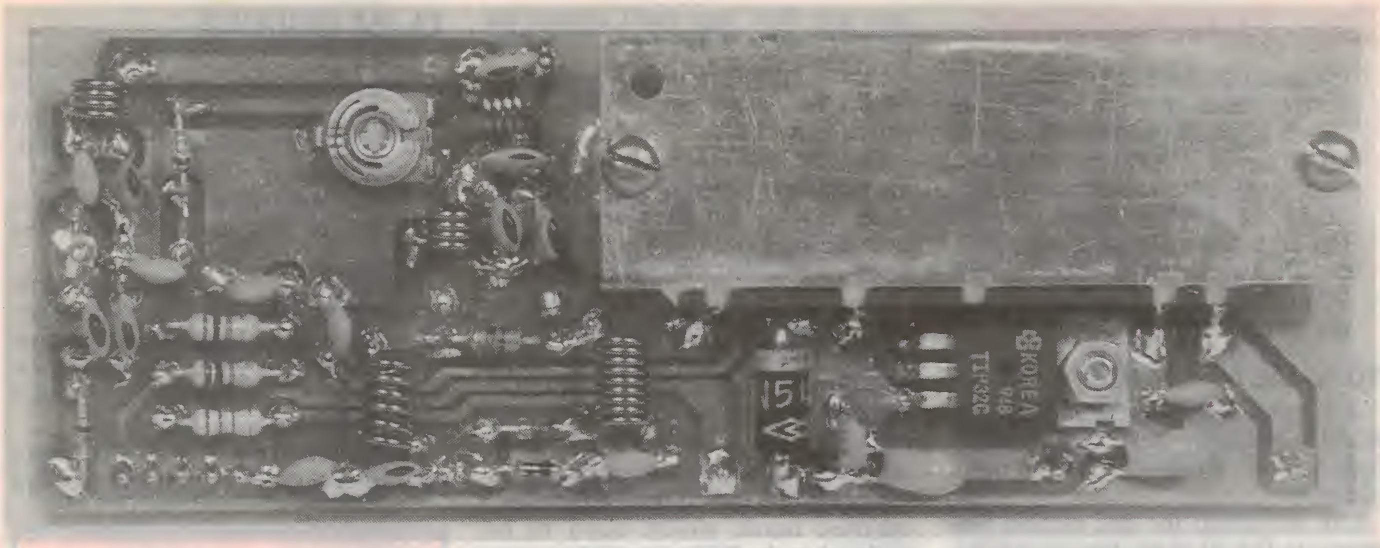
This section of the circuit is that covered by the schematic shown in Fig.5 of the January article. It comprises the mic preamp proper, plus a simple dual-diode limiter and low pass filter. The relatively small number of components involved are all identified with a '5XX' number; they are fitted to the main board very near its centre, and just to the right of the VCO/PLL shield box.

As before begin assembly with the low profile resistors and diodes, and work through the capacitors to the deviation trimpot R512 and the transistors. Take the usual care with the polarised components — here C503, D501-502 and the three transistors. Also make sure you don't confuse the PNP transistor Q503 with the other two, which are both NPN types.

Be careful when fitting trimpot R512, as a number of different brands may need to be supplied by DSE, according to availability, and the leg shape and configuration may change between different manufacturers. Make sure that none of the trimpot legs touches the ground plane on the component side of the PCB. If it looks as if this could happen, then either trim the leg(s) with sidecutters, or use a 4-8mm drill bit to increase the ground plane clearance around the PCB hole(s).



A general view inside the completed transceiver. Note that the PA module board mounts vertically at the rear of the main board with two 3mm machine screws clamping it and U801 to the rear panel and heatsink radiator.



A close up of the track side of the PA module board. Virtually all of the components are mounted on this side, as you can see. Note too that the amplifier module U801 (top right) effectively mounts 'upside down', with its heatsink uppermost.

Note too that some of the components have one lead soldered to the PCB's top ground-plane copper as well as underneath, just as in previous sections of the circuit. Don't forget to make these top joints, but at the same time take the usual care not to overheat the components when you're doing so.

There are two PCB pins to be fitted for this circuit section: those for the 'mic input', just to the front of C501-502. The earthy pin is that nearest the VCO/PLL shield box, and this must be soldered to the top ground-plane copper.

That's really all there is to assembling this section. But before you can fire it up for testing, you'll need to make a temporary connection between the microphone socket and the 'mic input' PCB pins on the board, just fitted. Do this with a shielded cable about 200mm long. Use audio cable and not true RF coaxial cable, which has a tendency to be microphonic at audio frequencies. In addition, audio cable tends to attenuate RF more than true coax, and this is desirable for a transmitter's microphone lead.

Testing the preamp

1. Connect a modulation meter or 2m FM receiver to the TX-RF output at the back of the main board. **Do not connect the 'TX 12V' positive supply for Q305 at this stage, though. If it is still connected from testing the RF driver stages, disconnect it before turning on the power. Otherwise, your meter or receiver front-end could easily be damaged by the driver's output. We're going to perform this section's tests without Q305 powered up, for safety. Enough signal leaks through the unpowered stage to allow this to be done.**
   If you're using a receiver, it might be a good idea to make sure you don't overload its front end by using an adjustable RF attenuator (say 20-100dB) in series with the input connected to TX-RF. Otherwise use a small series capacitor — say less than 5pF.
2. Connect a microphone, apply the +13.8V power and ground the PTT line — either via the microphone switch, or via the wire link used previously.
3. Using a normal level of speech, adjust R512 for a deviation of about 3.5kHz as read on the deviation meter. If you're using a receiver, adjust R512 until the modulation level is comparable with other FM signals on the 2m band.

PARTS LIST 7: Microphone preamp

Qty	Description	Location
1	330 ohm 1/4W	R511
1	560 ohm 1/4W	R504
1	1.5k 1/4W	R514
1	5.6k 1/4W	R502
2	15k 1/4W	R505, R513
1	22k 1/4W	R506
1	39k 1/4W	R507
2	56k 1/4W	R509, R510
3	100k 1/4W	R501, R503, R508
1	10k trimpot	R512
1	270pF ceramic	C504
1	1nF ceramic	C501
1	2.2nF ceramic	C505
2	0.1uF ceramic	C502, C507
2	33uF/10V tantalum	C503, C506
2	1N4148 diode	D501, D502
2	BC548 transistor	Q501, Q502
1	BC558 transistor	Q503
1	200mm length shielded audio cable	

Troubleshooting

In the fairly unlikely event that you weren't able to carry out the above test, because there isn't any modulation, here are the suggested troubleshooting steps:

1. Check for the following DC voltages:
   Q501 collector 1.2V
   base 0.6V
   Q502 collector 2.2V
   emitter 0.6V
   base 1.2V
   Q503 emitter 4.2V
   base 3.6V
   D501 anode 3.6V
   cathode 3.0V
   D502 anode 3.6V
2. If the above voltages seem OK, connect an audio generator to the MIC input, set to about 1kHz and with an output of 1mV RMS. Then check the voltage gain of the overall preamp circuit with a CRO or audio millivoltmeter, by comparing the signal at the emitter of Q503 with that from the generator. THe gain should be about 50dB (i.e., around 300 times).
   If you increase the input signal to around 2mV RMS, the limiting action should start to become evident. The maximum signal level at the emitter of Q503 should be about 2.5V peak to peak.
3. If the foregoing tests suggest that

the preamp itself is working correctly, check that the modulating signal is present at the collector of Q402 (in the VCO/PLL shield box). The level here should be around 30mV for an input signal of 2mV. No signal here would suggest a problem associated with trimpot R512, resistors R513-514 or coupling capacitor C403.

10. S-METER & ALC

All going well, you should now be ready to tackle the next section, which includes the S-meter and ALC drive circuitry.

The schematic for this section was shown in Fig.10 of the January article. Its components are all coded '6XX', and they again mount on the main PCB near the centre — between the mic preamp just completed, and the receiver audio amp section which we wired up last month.

As before it's a good idea to start with the low profile resistors and diodes, then the capacitors and trimpots and finally the transistors.

This time there are six trimpots, and as before it's important to make sure that their legs don't contact the ground plane of the PCB — unless they are meant to be soldered to it, as is the case with R603, R613 and R616.

Take the usual care with orientating the polarised components, of course. Here they are the six transistors, the five diodes D601- 605, and the two tantalum electro's C605-606.

Needless to say it's also important not to confuse the PNP and NPN transistors. The BC558 (PNP) devices go into locations Q601, Q603 and Q604, with the BC338 NPN device in location Q606 and BC548 or similar NPN devices in locations Q602 and Q605.

As before some of the devices have earthed leads which need to be soldered to the PCB groundplane copper as well as underneath. These include diode D602 and transistors Q603, Q605 and Q606; I suggest that you use a small clamp-on heatsink to prevent them from damage during the soldering to the ground-plane.

There are four PCB pins to be fitted to the board for this section, in the holes marked FWD, REV (both near D605), ALC and T8V (both near Q605). If you still have a short length of insulated wire connected to the 'METER' input on the front edge of the main PCB (near C711), from your previous testing of the display board, cut this to an appropriate length and use it as the link to the other METER connection point, between trimpots R606 and R607. It's rather easier to do this *before* you fit the two trimpots, by the way...

Your S-meter and ALC section should now be complete, and ready for the only test we can easily do at this stage:

Testing the S-meter

1. Adjust R603 to its minimum value (fully anticlockwise) and R607 to its maximum value (fully clockwise).
2. Connect an RF signal generator to the RX-RF input, set for a few microvolts. Otherwise connect to an antenna, and tune for a strong signal.
3. Adjust R606 until the LED level meter (display board) reads half scale.

Note that final adjustment of the S-meter really needs to be done together with the ALC control circuit, and the latter can't be easily tested or adjusted until the PA module is assembled and connected — so more about this shortly.

PARTS LIST 8: S-Meter & ALC

Qty	Description	Location
1	1k 1/4W	R605
1	2.2k 1/4W	R602
5	10k 1/4W	R608, R610, R611, R614, R615
2	100k 1/4W	R604, R609
1	220k 1/4W	R601
1	200 ohm trimpot	R603
1	5k trimpot	R612
1	10k trimpot	R616
1	50k trimpot	R613
2	100k trimpot	R606, R607
4	10nF ceramic	C601, C602, C603, C604
2	10uF/16V tantalum	C605, C606
5	1N4148 diode	D601-605
3	BC558 transistor	Q601, Q603, Q604
2	BC548 transistor	Q602, Q605
1	BC338 transistor	Q606
4	PCB pins	

11. PA MODULE

At this stage your transceiver's main PCB assembly should be effectively complete and operational, so that you're ready to tackle the final section: the PA module. This mounts on a separate small PCB, which mounts vertically at (and on) the rear of the case.

The schematic for the PA module was shown in Fig.9 of the January article, while its wiring overlay is shown in this article to guide you in the assembly. The components for the module are all coded '8XX'.

A difference between the PA module and the rest of the transceiver is that

PARTS LIST 9: PA module

Qty	Description	Location
1	180 ohms 1/4W	R802
2	1k 1/4W	R801, R803
1	100 ohm trimpot	R804
1	1pF ceramic	C816
1	3.3pF ceramic	C817
1	5.6pF ceramic	C810
1	12pF ceramic	C814
1	18pF ceramic	C808
1	39pF ceramic	C809
2	56pF ceramic	C811, C812
8	1nF ceramic	C802, C803, C804, C805, C807, C813, C815, C818
2	22uF/16V tantalum	C801, C806
2	1N4148 diode	D804, D805
1	1N5402 diode	D801
2	MI301 diode	D802, D803
1	MI407 diode*	D806
1	TIP32 transistor	Q801
1	M57737 RF amp	U801
10	PCB pins	
2	8mm long brass spacers	
1	M3x6 (or 1/8" x 1/4") screw and nut	
1	Heatsink radiator	
2	Screws to suit heatsink	
1	PL259 coax socket	
1	Metal rear panel for case, punched	
2	60mm-long sections of PTFE coax	
1	0.5m length 0.8mm enamelled wire	

* Or two MI402 or MI308 diodes in parallel, as available.

here virtually all of the components are mounted on the 'track' side of the PCB, except for the PCB pins used for the connections to the main board and antenna socket. These are mounted from the ground-plane side.

The key component of the PA module is the M57737 hybrid power amp (U801), which actually mounts on the PCB 'upside down', with its metal heatsink flange/mounting plate uppermost — so that it can make good thermal contact with the metal rear panel of the transceiver case, and the finned radiator.

Two long machine screws are used to clamp the PA module PCB and U801 to the rear panel/radiator, so that ultimately it is the rear panel which supports the overall assembly inside the case. To facilitate this mounting arrangement, two 8mm-long brass spacers are used to provide a solid mechanical link between the flange of the M57737 and the PA module PCB. These spacers are soldered to the copper on the track side of the PCB, so that they are concentric with the holes for the power amp's mounting screws.

As soldering these spacers to the board involves a fair bit of heating, it's important to do this before mounting any of the other components, so that they aren't damaged during the process.

With this soldering operation completed, the assembly of the rest of the PA module's components can proceed in the usual way. As usual, it's probably easiest to start with the low-profile components first — the resistors and diodes. At this stage it's also easy to fit the 10 PCB pins, which are pushed through from the ground-plane side, but soldered on the track side.

By the way, the fact that all of the components mount on the track side of the PCB calls for special care in preparing their leads, and soldering them in place.

In many cases they need to be bent fairly sharply close to the body, without causing strain, and then also soldered close to the body to minimise lead length — again without damaging the component.

Before mounting the capacitors, trimpot and transistor, you should wind and fit the coils. As before, the coil winding details are shown in a separate box, to guide you in getting them right.

Take particular care when winding the coils. There are only five, but they're all fairly critical for correct transceiver operation; so a little patience at this stage could save a lot of trouble later on.

Note that coils L801 and L803-805 are wound with the turns close together, but L802 is wound with a spacing of about 1mm between each turn. The total length of this coil is therefore very close to that for L801. All coils for the PA module are mounted between 1 and 2mm above the board.

With the coils wound and soldered to the board, you can fit the capacitors, trimpot R804 and transistor Q801.

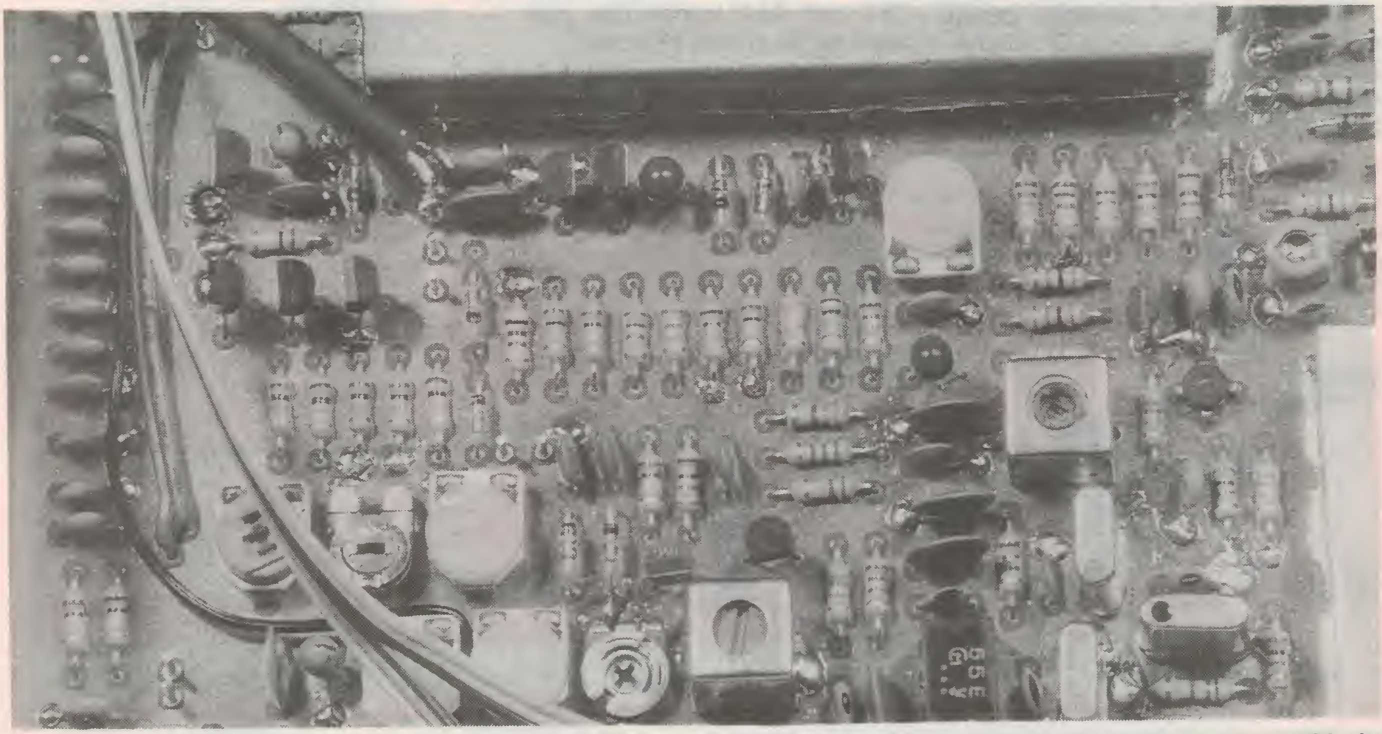
As before, some of these components have earthed pins which must be soldered to both sides of the board. Note that this applies to two of the pins of R804, while the third pin connects only to the track copper on the side line of the directional coupler. You may need to shorten this pin a little, so that the pot can be mounted squarely.

The hole in the PCB beneath R804 is to allow its adjustment using a small screwdriver or alignment tool, from the ground-plane side, when the transceiver is assembled.

Before mounting the pot, check that this hole is of about 3mm in diameter — it will be very difficult to drill it out to this size once the pot is soldered in place!

You'll need to be especially careful in mounting the ceramic capacitors, as in many cases these have one lead soldered only to the solder side, but the other passing through a hole and soldered to both sides.

And as both joints need to be made as close to each capacitor body as possible, to minimise lead inductance, you'll need to break away the ceramic flash from the leads very carefully by squeezing with needle-nosed pliers.



Here's a shot of the central section of the main board, showing the mic preamp components at upper centre with the S-meter/ALC section components below and to the left.

2m Transceiver

Then scrape the exposed leads clean with a small scalpel, to ensure that the joint can be made quickly and with no more heating than is necessary for good 'wetting'.

The final step is to fit the M57737 module, U801. This is done in the following way. First, bolt the device to the board (upside down, of course) using a pair of 3mm or 1/8" machine screws and nuts, with the screws passing through the spacers.

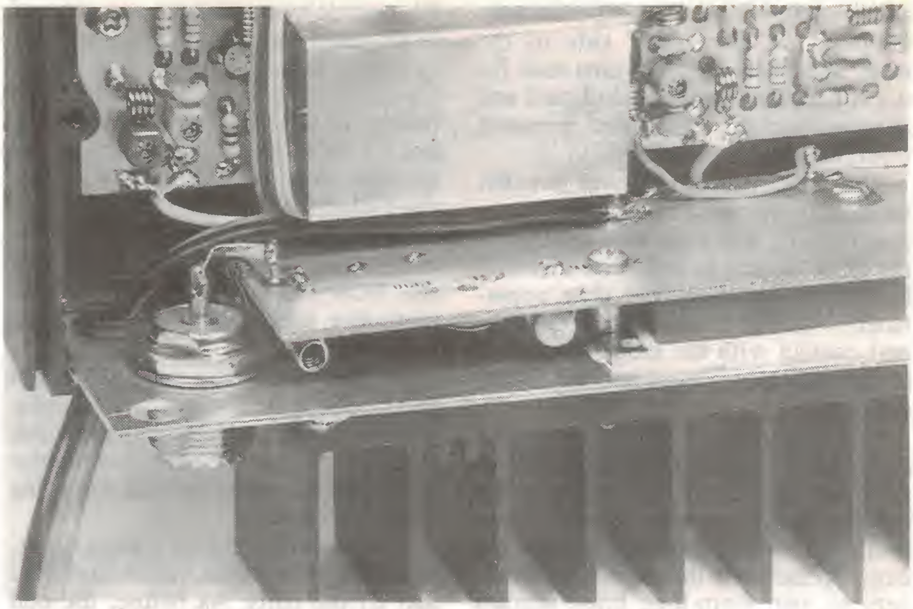
Then form each of the wire leads of the module into a tight 'U' shape, so it is thicker than a single wire, and then solder them to the board as directly as possible.

This done, carefully remove the screws, put heatsink compound between U801's mounting flange and the rear panel — and also between the rear panel and the heatsink — and then screw them all together with the screws designed to mate with the tapped holes in the radiator.

Needless to say, as you tighten up the screws, it's important to make sure that the PCB, body of U801, rear panel and radiator are all squared up correctly.

Mount the antenna socket to the rear panel and connect its centre spigot to the adjacent 'antenna' pin on the PCB with a short but stout wire link — or a short length of brass shim, 2-3mm wide.

The earthy side of the socket should also be bonded to the PCB ground-plane copper, near the same pin. Then strip two 60mm long PTFE coaxial cables as in the small diagram — removing 10mm of the outside insulation, compressing the braid back to about 2-3mm in length and stripping 5mm of the inner insulation — and solder them to the TX-RF and RX-RF connections of the PA module PCB, on the ground-plane side.



A close up of the antenna connector end of the PA module, when the latter is mounted inside the case. Also visible are the coax connections to the main PCB.

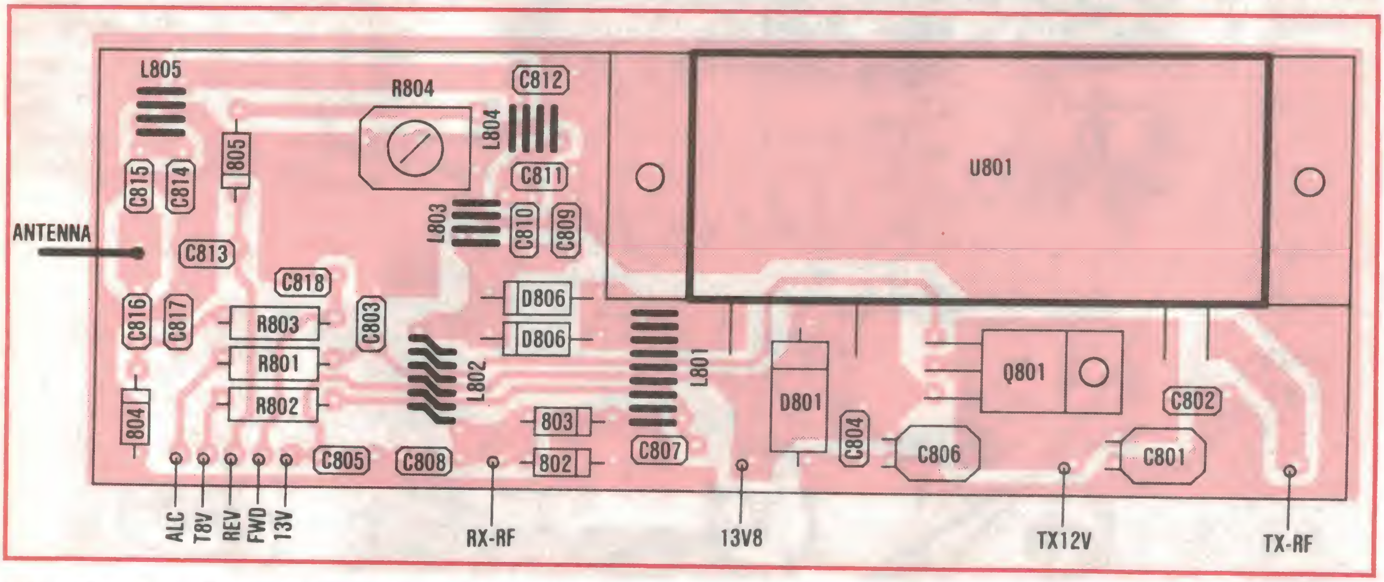
The shield braid goes to the ground-plane copper, while the centre conductor connects to the pins. Solder one 60mm long wire to the TX12V point and a five-wire ribbon cable about 250mm long to the 13V, FWD, REV, T8V and ALC connection pins — again on the ground-plane side.

Now you can fit the PA module board assembly and the main board into the case and solder the 'other ends' of these cables to the main board. The ribbon can be cut to length for a neat appearance, but note that the shield braid of both coax cables must be connected to the ground-plane copper of the main PC board.

Finally, you can introduce the transceiver's main 13.8V supply input cable to the PA module board. The red positive lead goes to the '13V8' pin, again on the ground-plane side, while the black negative lead goes to the ground-plane copper just near it.

Testing the PA

1. Connect a 50-ohm dummy load and wattmeter to the antenna socket.
2. Adjust R804 to the centre of its rotation, R612 and 613 on the main



The PCB overlay/wiring diagram for the PA module. Note that apart from the PCB pins, all other components are mounted on the track side of the board. Coil winding details are shown separately in a table.

PCB to their maximum value (fully clockwise) and the rotor of R616 to its ground end — again, fully clock wise.

3.Connect the 13.8V supply, in series with a DC ammeter set to a range of at least 10 amps FSD.

4.Connect the PTT pin to ground, either via the mic PTT button or a wire link, and peak trimcaps C331 and C336 (near Q305 at the rear of the main PCB) for maximum power output. The wattmeter should indicate between 30-35 watts, while the current drawn from the power supply should be about 6-7 amps.

5.Adjust trimpot R612 until the ALC circuit reduces the wattmeter reading to 25 watts. The ammeter reading should also fall, to around 5 amps.

6.Now release the PTT button or remove the link, and select low power by pressing the 'LOW' keyboard button.

7.Close PTT line again, and this time adjust trimpot R613 for an output of 5 watts as read on the wattmeter.

8.Switch off, select high power again and connect a DC voltmeter between the 'REV' line, at its PA module PCB pin, and ground. The meter positive should go to the PCB pin, and negative to ground.

9.Now close the PTT again and adjust R804 on the PA module (using a small tool via the access hole) for *minimum* reading. If you are getting a reading of zero over a fairly wide range of adjustment from one end of the trimpot to a certain point, adjust the trimpot to that point.

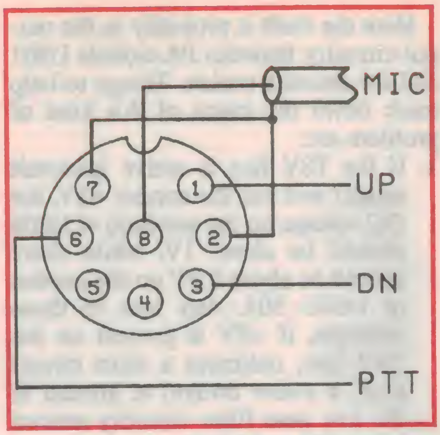
10.Adjust trimpot R616 so that the current from the power supply is less than 3 amps when the antenna output is either disconected or shorted to ground, with the PTT activated. Note that this adjustment should be carried out in periods of no more than than five seconds, with longer stand-by periods, to prevent overheating and damage to U801 (they're quite expensive!).

11.Adjust trimpot R607 for a 'full scale' reading of the front-panel LEDs (i.e., all on) when the PTT is activated with the transceiver in high power mode.

12.Select low power and verify that in this case only about four LEDs come on when the PTT is activated (a power ratio of 1:5 corresponds to a voltage ratio of around 1:2.3).

Troubleshooting the PA

All troubleshooting of the PA module should be carried out with the transceiver connected to the dummy load and wattmeter, and with an ammeter connected in series with supply.



Connection details for the microphone socket. These connections should suit most standard microphones.

Note that the supply current should not exceed 10 amps and the temperature of the heatsink radiator should not exceed about 80°C for any significant time. If necessary, turn off and allow everything to cool before continuing.

If while troubleshooting, it is necessary to work on the track side of the power amplifier PC board, attach the power amplifier module to a large heatsink, using two bolts through the module's mounting flange.

By attaching the module to one corner of the heatsink, the rest of the components on the PCB will be easily accessible.

If the current exceeds 6A, all testing should be carried out in short periods of five seconds, or less, with longer (more than 20 seconds) stand-by periods with the transceiver in receive mode (PTT released).

By observing these precautions you should avoid damaging the expensive power amplifier module.

Basically, there are two main kinds of problems that are likely to arise:

a. Low or zero power output, and low supply current.

b. High supply current, but little or no output.

For the first kind of problem, and assuming that the supply current is roughly proportional to the output power, the PA stage itself is probably OK, and the fault is likely to be due to low drive or a fault in the ALC circuitry.

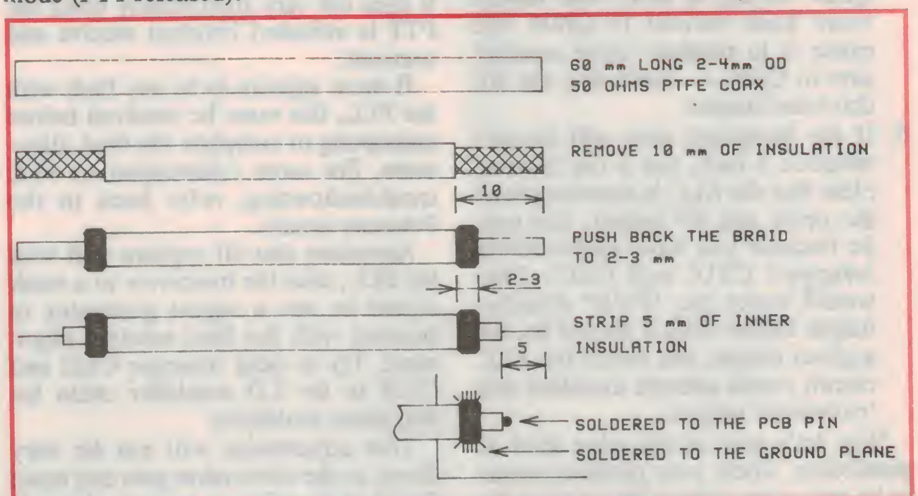
As a guide, the efficiency of the PA should be about 50%. The rest of the low-power circuitry draws about 1A, so that if you subtract this figure from the total supply current, and multiply this by 13.8V, you'll have a close estimate of the DC power input to the PA stage.

So if for example the total supply current is 4.7A, this means that the PA is drawing about 3.7A; 3.7 multiplied by 13.8 gives around 50 watts input. So if the RF wattmeter reads 25W, this would mean a PA stage efficiency of 50% amps.

These are the kind of figures you should expect, and if the power output is low, a PA efficiency of around 50% would tend to confirm that the trouble is elsewhere — either in the driver stages around Q304-305, or the ALC circuitry around Q603-606.

Here are some suggested further tests, to assist in tracking down the cause of low drive:

1. Check the RF drive power available at the TX-RF output from the main board, as described in section 8 of last month's article (March). If the



This diagram shows how to prepare the ends of the short PTFE coax cables used to carry RF between the main board and PA module.

drive was previously OK but is now low, and the 'TX12V' supply to Q305's collector is also low, there is probably a fault in the ALC circuitry (which includes Q801 on the PA module PCB).

2. Measure the voltage on the collector of Q801. This voltage should be close to 13 volts. On the other hand the voltage on the collector of ALC driver transistor Q606 (near the front of the main PCB) should be close to zero — or at least well below 12V.
3. Check that the voltages on the anodes of D603-605 are low. If any of these are high, this will cause the ALC circuitry to disable transmission. The cause of an inhibiting signal on one of the diodes should be traced back through the relevant circuits.
4. If the voltage on the base of Q605 is low and the voltage on the collector of this transistor is low also, the problem will probably be around transistors Q603-604. The base of Q603 should be at about 6V, set by the voltage divider formed by R611 (10k) and trimpot R613 (50k) connected to the T8V line. The common emitter voltage of Q603-604 should be around 0.6V higher than this figure.

   Q603-604 basically compare the 'FWD' voltage at the base of Q604, fed back from output voltage detector D804, with the voltage at Q603's base. If the FWD voltage is lower than that on the base of Q603, even by a very small amount, more current will flow through Q604 which, in turn, will supply more base current to Q606 and cause it to produce more conduction in Q801 — increasing the RF drive and output.
5. If the foregoing tests still haven't revealed a fault, but it has become clear that the ALC is throttling back the drive and RF output, this may be because you have inadvertently swapped C816 and C817. This would make the 'FWD' detector output higher than it should be, for a given output, and hence the ALC circuit would attempt to reduce this 'excessive' output.

Now let's look at the other kind of possibility, where your problem seems to be excessive current drawn from the DC power supply, with little or no RF output.

Here the fault is probably in the output circuitry between PA module U801 and the antenna socket. Things to help track down the cause of this kind of problem are:

1. If the T8V line is active (transmit mode) and has the correct +8V, the DC voltage on the anode(s) of D806 should be about 1V, while there should be about 0.5V on the anodes of D802- 803. Any lack of these voltages, if +8V is present on the T8V line, indicates a short circuit (e.g., a solder bridge) to ground in the low pass filter circuitry around L803-804 and L805.
2. The RF signal in the PA output circuit can be followed with an RF diode probe, providing it uses RF diode(s) having a reverse breakdown voltage rating of at least 150V. But note that the RF voltage will not register the same at all points along the low pass filter, due to the changing impedance levels along the filter.

12. FINAL ADJUSTMENT

If you have been able to align each of the transceiver's circuit modules according to the foregoing description, your transceiver should now be very close to its final adjustment.

However there are a few last 'fine tuning' steps needed to make sure that it's giving optimum performance.

Firstly, check the PLL voltage at R424 to see that it is varying smoothly as the channel selector is varied from one end of the band to the other (refer to testing step 8, in section 5 of the February article).

It should not drop below 0.5V, nor fly above 4.5V, at any frequency within the band. Also, check to see that it does not vary significantly when the PTT is switched between receive and transmit.

If there appears to be any fault with the PLL, this must be resolved before attempting to complete the final alignment. For more information on PLL troubleshooting, refer back to the February article.

Assuming that all appears well with the PLL, tune the tranceiver to a weak signal or use a signal generator to proceed with the final receiver alignment. Try to peak trimcaps C323 and C328 in the LO amplifier chain for maximum sensitivity.

This adjustment will not be very sharp, as the conversion gain and noise figure of the mixer is not very dependent upon the level of LO signal.

Now peak the trimcaps in the front-end RX amplifier (C301, C302), and the bandpass filter (C306, C308, C310 and C312). Also check the peaking of the two IF coils L307 and L201. If necessary adjust the discriminator coil, L202, in the IF amplifier for centre frequency (minimum receiver distortion).

This completes the final alignment. The transmitter stages should require no further adjustment.

Your transceiver should now be complete, although you may need to add the final touches if you haven't done these already: fitting the microphone socket to the front panel (see connection diagram), hooking up the CPU backup battery leads to the pins on the main PCB just to the front of Q901 (the + lead to the pin nearest Q901), mounting the speaker into the top of the case and then screwing everything together.

PA MODULE COIL WINDING DATA

Number of turns:	Winding direction:	Locations on PCB:
8-1/2	cw	L801
5-1/2	cw	L802
3-1/2	ccw	L803, L804, L805

All coils are wound on a 1/8" diameter former (e.g., the shank of a twist drill) with 0.8mm enamelled wire (#20 B&S, #21 SWG).

POSSIBLE MODS

On one of the prototypes, it was noted that the transceiver's ALC circuit was disturbed by radiation from a nearby antenna.

The antenna was a dipole about half a metre away from tranceiver. With full power output the power suddenly dropped down.

If this occurs, solder a 1uF tantalum capacitor, in parallel with a 1nF ceramic, between the base of Q604 and ground. The same filtering should be added between the anode of D605 and ground.

Further protection against possible disturbances due to stray RF should be gained by painting/spraying the interior of the transceiver case with conductive paint, and connecting it to the main PCB ground-plane.

If the VCO-PLL seems to exhibit any microphonic effects, these should be eliminated if the VCO components are sealed in wax. ■

Moffat's Madhouse...

by TOM MOFFAT

A celebration of April 1

Imagine this scene: a worker in an office, typing away on a computer. The phone rings, the worker abandons the computer for a minute to answer it. Glancing back to the screen, he notices one of the characters has 'slipped' down a line. What's this? He looks away again, and then back — a couple more characters have slipped. Soon they're slipping all over the place; the screen is melting in front of his very eyes. Help!

A new, never-seen-before fault? No, just the work of a little computer program called DRIP. The result of a very clever programming effort, possibly lots of hours of work for — a practical joke.

Considering the time of year (April and all that...), it's time to forget about war and recession and human misery in general and have a little fun. Practical jokes — life wouldn't be bearable without them.

There are plenty of classics in the electronics game, such as sending a new chum out to get a left-handed spanner or a metric shifter. In the days of valves and high voltages, we used to do nastier things, like leaving charged capacitors on the workbench for others to pick up. Looking back on it, that was somewhat dangerous. What if the 'victim' had a bad heart?

That trick served a useful purpose, only once. Back when I worked on a missile test range, things were pretty free and easy, and many electronic labs were in isolated areas, far from the prying eyes of the bosses. People used to bring their dogs to work so they wouldn't have to leave them home alone. The dogs used to snooze contentedly under the workbenches — except for one, who loved nothing better than to chew on electrolytic capacitors. One charged capacitor cured the dog of his chewing habit, forever, and for a while he even thought twice before chewing dog food!

Tricks like that have an edge of cruelty and even danger about them, but the advent of the computer has meant that you can give someone a really good mental shaking-up without any danger of physical harm at all.

Viruses are a current form of trick that produce lasting damage; they are used for malice, not fun. No way. What we're talking about here are simple little programs that run on the computer, do their thing, raise a good laugh, and then disappear. Serious computer users would consider these programs too trivial to even think about, but when used creatively the results are quite stunning.

Largely unused...

Un-named sources within the Tasmanian Government say the following story is absolutely true, although certain details must be suppressed for reasons that will become obvious. It seems that the Tasmanian Government had acquired a large supply of Olivetti PC's for use in government offices. However reports from within indicated that the inhabitants of many of these offices wouldn't have a clue what they were supposed to use the computers for.

Not so in one department, which had among its staff many people who could only be described as 'hackers', in the nicest sense of the word. The Olivettis in their offices were in daily use, running the addictive software that floats around the user groups and bulletin boards. One of these little gems is a public domain program called 'DRAIN'.

When it became obvious to the powers that be that the PC's weren't getting the use that they deserved (many were still packed away in their boxes), a team of 'experts' was commissioned to work its way through the public service, pointing out to the personnel therein that the computers were there to be used and loved. PC's were set up, plugged in, and booted, and the staff were suddenly made computer literate.

The people in 'Department X' were notified in advance of the date and time they were to be visited by an expert, who would show them how to use their Olivettis. So the computer which the expert was to use for the demonstration was prepared for his arrival. A small edit was made to this machine's AUTOEXEC.BAT file (the list of instructions it executes on startup) to include the command 'DRAIN'.

When the expert arrived, he gathered the staff around him and then switched on the Olivetti. When he touched the first key, he was greeted with a message: '*** SYSTEM ERROR *** ! Water detected in drive A! Standby while water is drained!' This was followed by some convincing gurgling noises. The expert watched this with considerable concern, while the people standing behind him did a valiant job of stifling giggles.

The performance continued with another message: 'Spin dry cycle starting', now with some appropriate whizzing sounds, and then 'System OK now, you may proceed'. Proceed the expert did, carrying on with his prepared demonstration as if nothing had happened.

Small modification

As an appropriate memorial to this occasion, the office staff made a small mechanical modification to the Olivetti, installing a plastic tube into the back of the computer. The other end of the tube rested in a paper cup, half filled with water, which was placed to one side. It was a constant reminder of the day they became computer literate.

The following week the expert came back again, unannounced. This time he was accompanied by a gaggle of bureaucrats who were being taken around to see what a fine job he had done. One of these bosses noticed the paper cup, and the tube going into the back of the computer.

"What's that for?" he asked. "Oh", said the expert, "we've had some trouble with that machine getting water in its disk drive."

Standby for a press release from the Government Information Office, denying that this event ever happened. But remember, no matter what is said, you read about it first in *Electronics Australia*. A classic 'Gotcha'...

A more recent prank is a program called INSULTS. This one must be set up manually, perhaps while the victim is out to lunch. When the victim returns he sees the computer sitting there quietly, ready to resume work. But when he touches a key, the computer lets fly on the screen:

You dumb bucket of filthy sewer seepage.
You sloppy loaf of synthetic pig slop.
You predictable mound of soppy armpit hairs.
You atrocious bunch of radioactive ape puke.
You grotesque stack of infested frog fat.

What a fine collection! Just like in that Monty Python film, where the French knight stood at the top of the castle, hurling never- ending insults from the parapets. I remember that scene brought the house down, and I'm sure the computer version would bring the office down, too.

The INSULTS program can be set up to produce hundreds of insults in one go, but anything more than 24 or so scrolls past too fast to read. The program uses one of those random select-the-phrase routines, so 22,000,000 different insults are possible. Maybe the Monty Python people could use it to write scripts...

JIVE-ing around

And now the grand finale. Sick of reading boring old academic reports? How about those thrilling newsletters you get from your well heeled in-laws or yuppie friends around Christmas, telling you all the fantastic things they and their dear children have been doing? You can put a bit of spice into these documents with an automatic language translation program called JIVE.

Now ya' kin scribble likes dis. Throw some letta' t' yo' Aunt Sally o' yo' dear old motha'-in-law. Ya' know? Tell ha' all de borin' dings yo' kids gots been doin'. It might not be earth- shattrin' stuff but it gots' ta be baaaad fun t' eyeball, any-how. Ya' know?

(TRANSLATION: 'Now you can write like this. Send a letter to your Aunt Sally or your dear old mother-in-law. Tell her all the boring things your kids have been doing. It might not be earth-shattering stuff but it will be good fun to read, anyhow.')

The JIVE program obviously looks for key words in the text and substitutes Jive words. It also throws in comments of its own (Ya know? Right on!).

Some people might consider the whole concept racist, slinging off at black people. In America, Jive talk is sometimes banned from radio and television for this reason. This is a shame, because Jive has become a proper dialect of the American language. Over the years I have met many people who speak Jive properly, but with one interesting qualification: they only seem to use it when they're happy.

One of the best known practitioners of Jive talk was a radio announcer named Wolf Man Jack. Back in the 50's and 60's he used to broadcast from studios near San Diego, California, but the station's audio was sent by landline over the border into Mexico to a gigantic 500,000-watt AM broadcast transmitter. This thing ran 10 times the USA legal limit, it had a clear channel, and it blanketed the whole western half of the United States.

If you've ever seen a film called *American Graffiti*, you've heard (and seen) Wolf Man Jack in action. Back in my own treacherous youth I was one of his most devoted listeners.

The JIVE program makes a good Wolf Man Jack simulator. Take some plain language text: 'You're listening to the Wolf Man Jack radio show, coming to you from Acuna, Mexico through our big transmitter with half a million watts of music power. Let's dedicate this next number to the nice woman who called on the phone asking for something to make her man happy.'

Now to run it through JIVE: *'Youse listenin' t' de Wolf Man Jack transista' show, comin' t' ya' fum Acuna, Mexico through our big transmitta' wid half some million watts o' music powa'. Let's dedicate dis next numba' t' de supa' fine mama who called up on de phone askin' fo' sump'n t' make ha' dude happy. Ya' know?'*

Yes — that's the Wolf Man! It brings back memories of carefree times wid' da Wolf Man blarin' outa da car radio. *American Graffiti* all over again. As I remember, that film spawned a television series called 'Happy Days'. What an appropriate name.

Let's give JIVE one more go, on something longer: part of the January 'Moffat's Madhouse' column where the young boys in the cinema are watching a flying saucer film. I've had to censor this slightly, because the program got so excited it started emitting some slightly rude words. Also note its translation of the term 'black and white film':

Some time lata', afta' tension in de park, and de damn cinema had built t' breakin' point, some slit jimmy'd in de flyin' sauca' and some ramp slid out and down t' de ground. Den fum de wide slit emerged dis most gigantic and frightenin' robot, and would ya' reckon, his dojigger wuz Gort. Right On! His body wuz de prototype fo' screen robots t' mosey on down, right up into de 1990's, and de damn dojigger — Gort — how many times gots' ta dat been used since?

When de suckas saw Gort stompin' out along dat ramp, dey cowered. De soldiers cowered too, and made threatenin' gestures wid deir guns. And in de cinema, 500 young boys dropped deir pop-corn and lollies and threw deir arms around each otha'.

Gort took note o' de soldiers' threatenin' gestures, and he stopped. Yaass. Den dis viso' doodad ova' his eyes began t' jimmy, reeeall sloowww. Ya' know? Dere wuz no eyes, plum dis kind o' lens, pulsatin', threatenin', deep red. Das' Right! It wuz some brother and honky film but we knowed dat pulsatin' eye wuz red anyway, it plum had t' be. Das' Right!

Full-grown boys, eight, ten, twelve years old, brave boys, heroic boys, macho boys, warriors o' de future, some cinema full o' dem, all gots quiverin' lips. "What's he goin' t' DO??". Some couldn't snatch it and hit de damn floo' behind de damn seats. Others wuz simply too scared t' move. Dat's Right. Whut Gort DID, afta' all dat, wuz shoot dis sizzlin' ray at de damn soldiers. He didn't hurt de soldiers, but he vaporized deir guns. Fust lesson o' de day, dig dis: Soldiers be probably OK, but deir GUNS be bad. Right on!

Next month I guess we'll have to get serious. But until then we can still smile at computer-borne pranks and the infinite joys of the human language. As the unnamed author of the JIVE program says at the end of the program's instructions, 'It will definitely make you a better person in the long run.' Right on! ■

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

TV-locked frequency calibrator

The purpose of this circuit is to provide precise frequencies of 4, 2, 1 and 0.5MHz for frequency counter calibration, by 'borrowing' the very accurate timing of the signals transmitted by TV stations and phase-locking a crystal oscillator to them. In use, the 1V p-p video signal from a video cassette recorder receiving an off-air signal (NOT playing a tape!), is fed into the unit and the desired output frequency is selected by the switch.

Q1 operates as a sync pulse generator, conducting only on the negative sync tips, which the 330pF capacitor and 100k resistor turn into an approximate sawtooth waveform at 15,625Hz. IC1a is configured as a non-inverting squaring-up buffer whose output is a reasonably clean 15,625Hz square wave, which is applied to one input of IC1c, which is the phase comparator. IC1b is connected as an inverter/crystal oscillator whose precise frequency is variable by the 3-30pF trimmer and the BB119 varicap diode.

The 4MHz signal divided by the eighth power of 1 (= 15625Hz) is taken from pin 13 of the 4040 binary counter and applied to the other input of IC1c, the phase comparator, the output of which is a 31,250Hz waveform whose mark/space ratio and therefore DC level is determined by the phase difference between the TV and divided crystal signals. This is filtered into a DC control voltage by the 1M resistor and 0.1uF capacitor, biased by the 1.2M resistor and applied as a tuning voltage to the varicap diode via the 10M resistor, so as to keep the crystal phase-locked to the video signal.

The 4MHz output is obtained from IC1d functioning as a load-isolating buffer and the 2,1, and 0.5MHz outputs come from the first three 2 stages of the 4040.

Q2 and Q3 form another phase comparator which ensure that the LED only lights in the presence of an incoming video signal and that its brightness varies with phase, so as to indicate that the circuit really is phase-locked and not free-running.

The LED should be watched carefully for at least 15 seconds after switch-on, to ensure that its brightness is constant.

Set up of the circuit requires only an analog multimeter set to the low range and connected to the test point.

With no video signal connected the meter will read about 4V and this reading should be noted.

Then with an off-air video signal connected, it will be found that at the xtremes of the adjustment of the 3-30pF trimmer, the meter will swing wildly up and down scale. The trimmer should be adjusted **slowly** through the range between these extremes until the point is found where an increase in trimmer capacitance produces a rather slow increase in reading and vice-versa; then the trimmer should be carefully adjusted until the reading is the same as it was with no video signal connected.

This minimises the amount of phase jitter during the vertical sync pulses.

The original was built on a piece of matrix board attached to the rotary switch and installed in a small folded aluminium box with a pair of BNC connectors and the LED on the front.

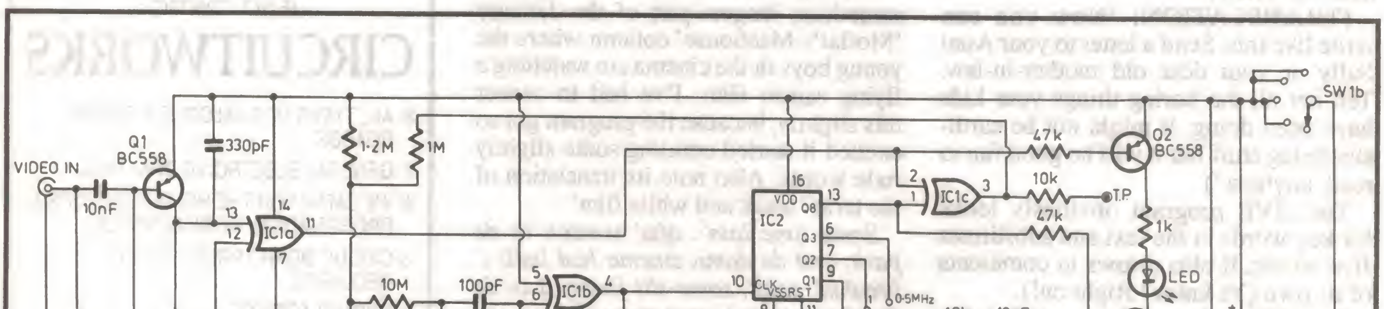
The crystal was a cheap HC18/U microprocessor one from Sheridan Electronics.

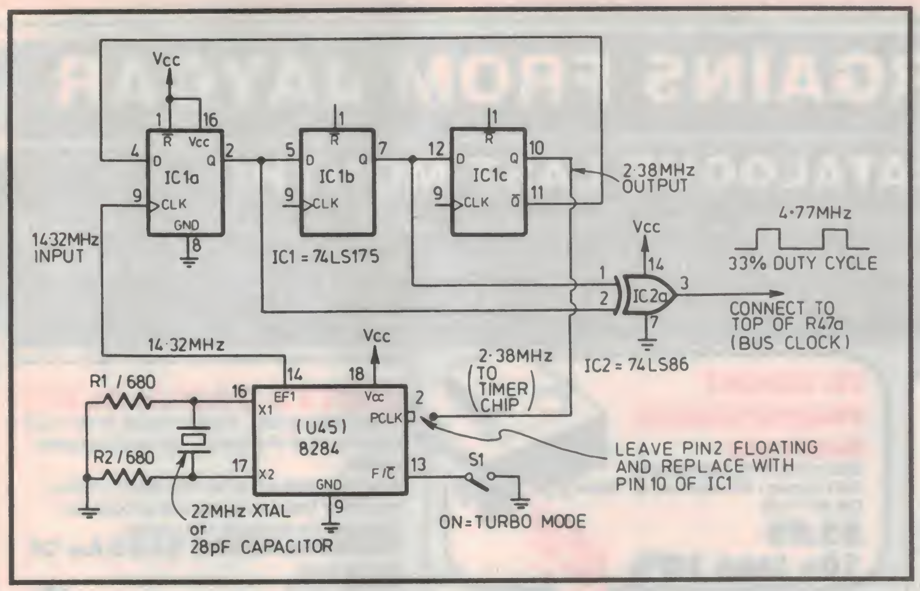
The trimmer capacitor should be a compression mica type for stability and readily accessible because it tends to need readjustment as the battery ages.

The current consumption of the original is about 8mA when phase-locked.

The original has been checked on a Hewlett Packard 5342A microwave frequency counter of known accurate calibration and once locked, the unit produced readings on all Sydney TV stations of 4,000,000Hz.

Bob Parker,
Carlton, NSW **$50**





'Turbo' board for Tandy 1000

The Tandy 1000 was a very popular PC compatible with a lot of software still being written to make use of its 16-colour mode and enhanced sound capabilities. But its speed of 4.77MHz is just too slow for many big applications. This 'turbo' board can give it a new lease of life, by increasing the system speed to over 7MHz, and with the inclusion of a V20 processor, gives it a Norton SI of about 2.7.

In the Tandy, the main oscillator of 28.64MHz is divided by 2 and fed to pin 14 of the 8284 clock generator IC (U45) at 14.32MHz. This chip also has an internal oscillator, whose frequency is determined by an external crystal (in this case 22MHz or less), which is connected to pins 16 and 17. R1 and R2 are used for stabilisation.

The turbo mode is selected by shorting pin 13 of U45 to ground (it is already tied high via a 10k resistor on the motherboard). This pin selects which clock (14.32MHz or 22MHz) is fed through to the internal divide by 3 counter, which produces the CPU clock signal with a duty cycle of 33%.

The CPU clock is internally divided by 2 to produce a 2.38MHz clock for the 2853 timer IC (U114). But if the turbo mode is selected then the clock will run fast. This will cause all sorts of problems and the computer will fail to work reliably. The solution is to add a permanent divide by 6 counter, driven by the 14.32MHz clock. This will replace the internal clock from pin 2 of the 2848, and will produce the correct 2.38MHz signal regardless of the mode selected.

The divide by 6 counter (IC1 74LS175) is simply a three-stage shift register with feedback, where the Q output of IC1c changes state every third clock cycle. Another problem that must be overcome is that the clock for the DMA chip (8237), located on the RAM expansion card, must be kept under 5MHz — or disk drive errors will result. The solution is to keep the BUS clock running at 4.77MHz, by dividing the 14.32MHz clock by 3. This is done with the exclusive-OR gate (IC2), which decodes the 2.38MHz shifting signal on the Q outputs of IC1a and IC1b, and produces the original 4.77MHz clock with a 33% duty cycle. This clock is fed to the BUS via R47a on the motherboard (located at the lower right of the third expansion socket). The top lead of R47a (connected to pin 16 of U82 a 74LS244) must be fitted or cut from the board, and pin 3 of IC2a connected to this end of the resistor.

The circuit can be built on a small piece of Vero board, with the 8284 being removed from its socket (lower right of the processor) and mounted in an 18-pin wire wrap socket soldered to the turbo board with its pins plugging into the original socket.

The IC's should be mounted end to end, so the board is as narrow as possible to avoid obstructing any expansion cards. Pin 2 of the 8284 must be bent outwards so that it isn't connected to anything and pin 10 of IC1 is connected to pin 2 of the wire wrap socket instead. Only a 22MHz or less crystal should be fitted and this gives a speed of 7.33MHz. If this crystal is a fraction too fast (you will get a memory error message at bootup) or you can't get a frequency this high, the crystal can be replaced with a capacitor of about 28pF or higher. This will result in a remarkably stable clock frequency of about 7.2MHz which can be easily adjusted.

In turbo mode not only will the processor and memory run faster, but the disk drive will show a significant increase in transfer and access speed. Also the processor must be changed to a V20 to be able to handle the extra clock speed, and as a bonus the V20 will help speed things up even more.

David Jones
Lethbridge Park, NSW **$45**

APRIL BARGAINS FROM JAYCAR

NEW CATALOGUE LAST MONTH!

The brand new 1991, 164 page catalogue was released last month. If you don't have your own copy simply call into any Jaycar store and pick one up for only $1. Or, send $2 to PO Box 185 Concord 2137 and we will post you one.

VARTA NiCad BATTERY MADNESS

VARTA 2.4V 100mA/h

These batteries are encased in a black plastic housing which measures 30(L) x 16(W) x 19(H)mm. They were removed from printed circuit boards by simply cutting of the PC terminals so to use you would need to break open the plastic case. Inside are two 1.2V cells. So purchase 4 of these, remove 1 cell and you have an 8.2V (9V 216 type) battery for only $4, not about $20. Ideal for Hobbyists, experimenters, etc. To buy these today they would cost about $13 ea.

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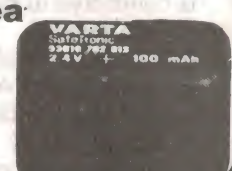

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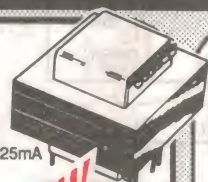

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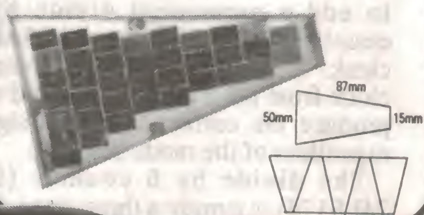

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Supplied on boxes of 100 pieces.

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Ref: EA April 1991
Using your CRO this kit and the Lissajous reference chart provided you can identify unknown devices, check whether they are defective and even identify their pin connections.
Kit includes box, transformer, switches, hardware and all components.

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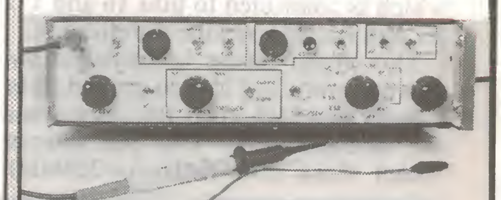

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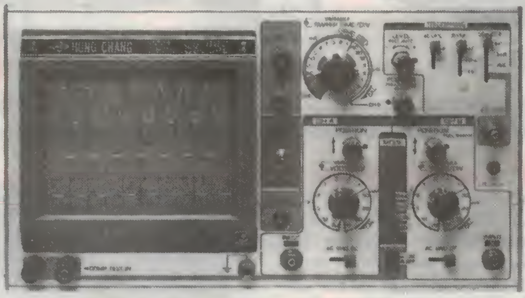

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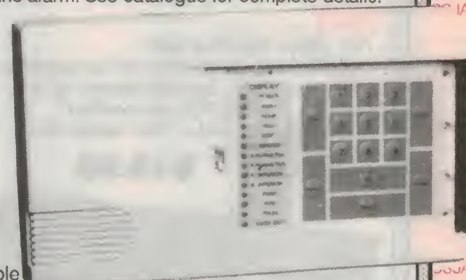

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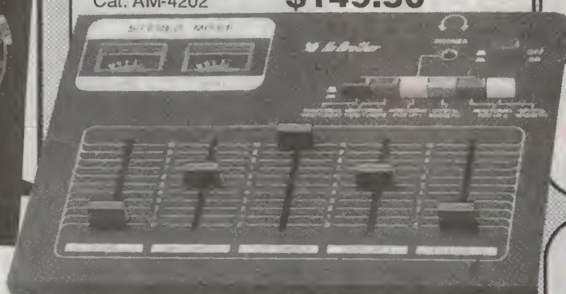
See catalogue for full details.

Cat. AM-4202 **$149.50**



Economy Digital Multimeter

17 range DMM at a price that must be the lowest in Australia. Who would have thought you could buy a quality DMM for under $35! Compact size which is ideal for tool boxes, glove compartments, etc. Uses a 9V 216 type battery for long life (100 hours).

FEATURES
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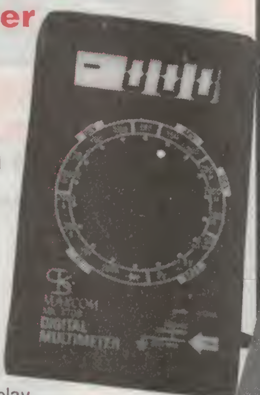
• 3 range battery checker
• Diode test
• Compact size 116(L) x 70(W) x 24(H)mm
• Easy re-calibration instructions supplied

Cat. QM-1430 **$34.95**



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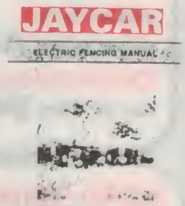
ELECTRIC FENCE MANUAL

If you are new to Electric Fences, you will need this manual. It has 12 pages full of very helpful hints and suggestions relating to fence designs and systems, types of energisers, fencing wire, gateway and creeks, batteries, solar panels, cut out switches, insulation, horse paddocks and fault finding.

Cat. BE-8300 **$3.95**



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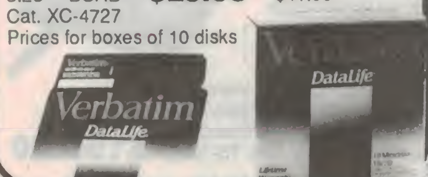
Prices for boxes of 10 disks



High Efficiency Electric Fence

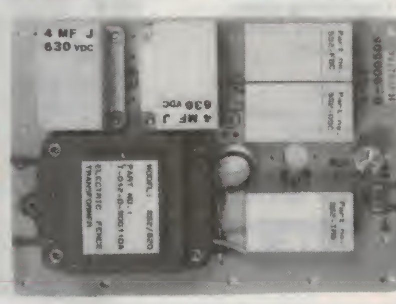
This Electric Fence has a high output and will energise up to 20km of live wire. It is a "short form" unit which consists of a fully assembled and tested PC board. No box or hardware is supplied.

SPECIFICATIONS

Input Voltage	9-15V DC
Input Current @ 12V	140-170mA
Output Energy @ 12V	1.0 Joules
Pulse Rate @ 12V	40-45 pulses per minute
Output Voltage @ 12V	No load 6,500V 2,500Ω 6,200V 500Ω 5,000V 200Ω 3,200V 100Ω 2,000V
Wire Length	20km
Bat Life with 100Ah Battery	26 days

Cat. ME-6010 **$139.50**

NEW FOR '91



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Ref: Silicon Chip Feb 1991
Check audio gear etc with this low distortion sine wave source. Low impedance up to 8 volts. Kit includes PCB, all specified components to build a 1kHz version. No plugpack supplied.
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The Flexitimer Kit

Ref: EA March 1991
This simple timer kit may be used as a parking meter reminder, or the basis of a full blown watering system. Kit includes PCB and all components.
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Fluoro Inverter Kit

Ref: Silicon Chip Feb 1991
This kit enables you to build a high power DC inverter suitable for driving a 20 watt fluorescent light from a 12V car battery. Short form kit. See catalogue for full details.
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Wash your windscreen with hot water and it uses no energy. You can install it in minutes. The Hot Jet water reservoir mounts on the radiator hose (between radiator and engine). Cut the thin tubing which carries water from the washer reservoir to washers and re-route through the Hot Jet reservoir mounted on the radiator hose. Activate the washers to fill up the Hot Jet reservoir, and in a short time the water will become hot for your windscreen. Everything supplied. Made in the UK and imported by Jaycar.
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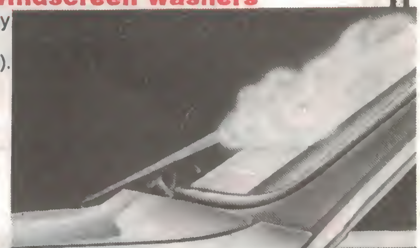

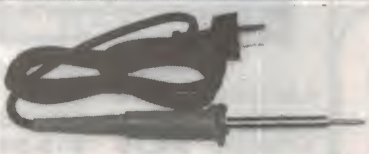

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Complete with cabinets.
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Makes your vehicle appear to be alarmed for under $8.
The pack includes a 120mCd 10mm diameter red LED, and a black bezel. The 120mCd LED is as bright as a normal red bezel. Unit requires a 14mm hole and simply snaps in. Add to this a couple of our burglar alarm stickers (Cat. LA-5100 - 95¢ ea) and your vehicle looks alarmed for under $8.
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See catalogue for full details
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10" 120Wrms
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DIGITAL MULTIMETER

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- Logic probe 20MHz
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- 10 amp
- 34 ranges
- One hand operation

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WAS $99.95
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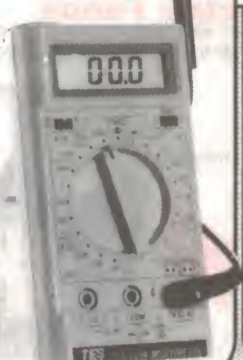

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THE OK SOLDERING STATION

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No more constant tip changing to select a different temperature.
For full specs see the brand new Jaycar catalogue. Cat. TS-1600 **$159.50**

Amateur radio Construction Project:

A Whip Antenna for 2 metres and 70cm

Most hand-held transceivers for the 2m and 70cm amateur bands come with a 'rubber ducky' helical antenna that's nice and compact, but not particularly efficient. Here's a simple, easy to build dual-band whip that will give much better performance.

by TOM MOFFAT, VK7TM

Amateur radio has certainly come a long way! Not too many years ago 'ham rig' meant a room full of equipment, with the main transmitter/receiver mounted in a large case on a desk, or even a floor-standing rack. Now, you can hold much the same thing in the palm of your hand.

Radio gear has evolved from the good old 'build it yourself' sets to things you'd never build in a million years — tiny hand- held radios with multiple circuit boards, filled with surface- mounted devices. With these little radios, usually running on the two-metre or 70-centimetre bands, we can talk all over the state or across the country.

This usually involves the use of mountain-top repeaters. But if we carry the little radios to the tops of mountains ourselves, we can work quite startling distances unassisted, and with microscopic power levels. This project is designed to help further that aim.

The modern 'HT' (handie-talkie) radio comes from Japanese manufacturers like Icom, Kenwood, Standard, and Yaesu. The radio itself is usually tiny; something in the order of a packet of cigarettes. There's usually a rechargeable NiCad battery that clips to the bottom, although at least one of the Icom models has done away with that and made the battery part of the back of the radio.

The antenna is almost always of the type known nowadays as a 'rubber duckie': a semi-flexible rubber covered whip that's either base-loaded or helically wound. The antenna is always made as short as possible, to keep it on a similar scale to the radio itself. Rubber duckies are fine for short-distance work, but over a long haul they're certainly not the best.

What we are making — the antenna mounted on an Icom IC-24AT VHF/UHF hand-held radio.

Because of their tiny size, their efficiency ranges from barely tolerable to downright shocking.

The old-timers used to say that the best antennas were the ones with a lot of wire up in the air, and the principle still holds true today. The antenna described here gets as much wire up in the air as possible, consistent with what is mechanically practical on a pocket-sized radio. The improvement in efficiency and in performance over a rubber duckie is quite remarkable, and all it's going to cost you is one BNC connector, some heat-shrink tubing, and less than a metre of coaxial cable.

Antenna design

This antenna is designed to work on two bands simultaneously — two metres and 70cm. On 70cm it acts as a 5/8-wave radiator, with a coil at the base to match the impedence to 50 ohms. On two metres it becomes a base loaded 1/4-wave whip. The entire antenna is around 460mm (18") long, and if constructed like the prototype it weighs around 15 grams — half the weight of the rubber duckie it replaces.

The design isn't new or original; back in the earliest days of two-metre activity in Melbourne, many hams used 5/8-wave 2m whips on their cars. These were made from commercial fibreglass whips around five feet long (we only had feet back then). The whips, made by Belling-Lee, were covered with copper braid much like co- ax, and then dipped in some kind of black waterproof gunk.

We used to cut away the first 1-1/2" of braid and sealant from the bottom, and wind exactly 11 turns of copper wire

over the bare fibreglass rod. This coil was soldered to the remaining copper braid at each end, and then it was covered with heat- shrink tubing. This arrangement made a fine, strong, and efficient two metre antenna, and as a bonus it worked extremely well on six metres. I had a diplexer gadget in my own car so I could work 6m FM and 2m FM at the same time, through the same antenna.

This new antenna is based on that older design, only it's scaled to 1/3 size, and consequently for three times the frequency. The materials are very different but the principle is the same: one antenna that works on one frequency band and another band three times as high.

Construction

First select some co-ax, either from your junk box, or you might even have to lash out and buy a couple of meters. The stuff to look for is the very high quality 75 ohm co-ax used used in permanent cable television installations within buildings. This cable is of moderate size, about 8mm in outside diameter.

The centre conductor will be solid, not stranded. The insulation around the inner conductor should be semi-air-spaced; the stuff I used has five longitudinal supports running the full length of the cable, forming a sort of web to hold the inner conductor in the centre. The material appears to be polystyrene.

The shield on my cable was first a wrap of aluminium foil, covered by traditional copper braid, and on top of that was the usual black vinyl covering. This covering was not marked with any brand or type number; there was nothing at all! Otherwise I could just give you a type number and be done with it. The cable is obviously meant to be installed once within a wall or somewhere, and then left undisturbed forever. Because of the air-spaced nature of the insulation, any continuous bending or flexing would wreck the cable.

The beauty of this cable is that it's amazingly light. Yet because of the longitudinal braces making up the insulation, it resists bending. So when used as a whip antenna it stands up nicely without support, yet weighs next to nothing.

If you can't find cable similar to this, you'll have to resort to 'any old cable'. It will be heavier, and it won't stand up so straight. But be sure the cable has a solid centre wire.

As you construct the antenna keep a close eye on the photos; these should make the procedure quite clear. Begin with a piece of co-ax about 2/3 of a metre long. If you bought two metres of co-ax

Remove the inner part of the coax from the shield and the outer covering. Pull gently but steadily.

Slit the inner part along its length for about 75mm from one end. Try not to nick the copper conductor.

Pull the inner wire out from the slitted end, for about 75mm. Slow and steady.

Whip Antenna

this will give you three chances to get it right!

Cut away the shield and outer covering at one end, so you can grip the inner insulation with a pair of long-nose pliers. Have a helper hold the other end of the coax, and then pull gently and steadily. The white inner insulation and its centre conductor should come sliding out of the braid. Remove it completely, and put the braid and outer covering aside. Keep the braid; it will make a useful ground strap for some other project.

Now take a sharp knife such as an Exacto knife. Gently slit along the inner insulation for about 75mm at one end, laying the inner wire bare. Try not to damage the wire too much. Next fold the slitted insulation back so you can grip the inner wire with your pliers. Get your helper to pull the other end once more, and gently slide the wire out of the insulation so about 75 mm is exposed. This is going to be your loading coil.

Neatly now, bend the wire out through the slit, all the way to where the slit ends, so the wire is standing out at a 90° angle. Then carefully wind the wire around the insulation and the slit, for four turns, leaving somewhat more than a wire's width between the turns.

Now comes the only hard part. With your pliers you must bend and form the wire so you can insert it back into the slit again such that the bottom of the coil looks as neat as the top. You want the wire to slip right back into the centre of the cable if possible. Once this is done, what you're holding in your hand is your basic 5/8 whip, minus the connector. Nice, huh?

Next you must build out the insulation below the coil with one or more layers of heat-shrink tubing, so that its diameter matches the hole in the end of your BNC connector. Most of them in the shops seem to be the 75-ohm size, so the bottom of the antenna, along with the layers of heat-shrink, will end up about the size of the coaxial cable you started with.

The final layer of heat-shrink should cover the previous layers, as well as the coil itself and perhaps 25mm above the coil. This will give the coil and the base of the antenna some strength, and make the whole works waterproof.

Now it's time to install the BNC connector. The wire and the insulation will need pruning back, and the idea is to arrange things so the bottom of the coil ends up nice and close to the top of the connector; certainly no more than the coil's length away. If the coil is too far

Fold the wire out at right angles and then carefully wind a four-turn coil. Try to space the turns evenly, so they're nice and neat.

Push the wire back into the slit. A screwdriver would have been a better tool, with less damage to the wire.

Slip some heatshrink tubing over the slitted coax below the coil. This is where the connector will grip it.

A hair drier makes a good heat gun to shrink the heatshrink tubing.

The connector is installed. Everything looks good. Time to tune the antenna.

The antenna test set-up, attached by a rubber band to the car door. Antenna is attached directly to the EA Powermatch VSWR reflectometer head, Al-foil covered styrofoam sheet is sandwiched in between.

from the connector the antenna's match will be poor.

BNC connector designs seem to vary, so you'll have to work out for yourself how yours goes on. Just pretend you're putting it on the end of a piece of co-ax (well, you are, I guess!). If the connector is reluctant to slide over the heat-shrink tubing, a little talcum powder will ease things.

Tuning the whip

For this you will need an SWR bridge known to be accurate at both VHF and UHF. How fortunate that an instrument just made for the purpose was described in *EA* for September 1990, as the 'VHF Powermatch Mk2' project!

The gadget in the photo, strapped to the car door with a rubber band, is an original Powermatch reflectometer head from 1971. It's been in continuous use since then, and it's among the most useful instruments I've owned.

For tuning measurements it was necessary to provide some kind of a ground plane for the whip to work against. Being too cheap to waste a piece of sheet metal, I made up a ground plane from a chunk of styrofoam sheet around 200mm square, covered in aluminium foil. This had a hole poked through the middle to sit over the reflectometer's BNC connector; it was held in place by the BNC on the antenna which also made contact with the aluminium foil.

The ground plane was a bit small on UHF, and way too small on VHF. This was done on purpose to try to simulate the poor ground plane provided by the body of a handie-talkie radio.

You can use your HT radio as a signal source; I chose to use my VHF/UHF mobile in the car, to avoid flattening the HT's battery. This explains why the reflectometer was strapped to the car's door, to get the antenna out into the clear.

To tune the antenna you must snip small pieces off the top, sneaking up on the final length slowly and carefully. It's a good idea to stick a piece of masking tape near the 460mm length, so you'll be warned that you're getting close to optimum. If you cut the antenna too short there's nothing to do but to start over again with a fresh length of coax!

Before you begin, cut off the part of the insulation at the top which has had the wire pulled from within it. You want the next snip to be both insulation and wire. Now measure the VSWR at both 144MHz and 430MHz. These will probably be outrageously high, since the antenna will be way too long.

Concentrate on 144MHz for the time being, and begin to snip away at the top — about 10mm at a time, checking the VSWR after each snip. The VSWR should begin to improve slowly, and then more dramatically. When things really start to move you must begin checking 430 as well as 144MHz. You should also begin making smaller cuts, down to two or three millimetres at a time. The final tuning will be VERY critical.

Eventually you should reach a state where the VSWR at 144MHz is very good, but it's still quite horrible at 430.

Whip Antenna

Now you must keep snipping away very carefully, 'walking' the lowest VSWR point right up through the two metre band. As you keep making the antenna shorter, the VSWR on 430 will keep falling, and eventually you'll find it will be lowest on 431 or 431MHz. But now the low point on two meters will have slipped out the high part of the band! The final result will be a compromise.

Once your antenna has reached its final length you must waterproof the open end of the co-ax. A dab of Silastic does the job nicely, or you might be able to find one of those little caps that are meant to sit on the end of antennas. If you use Silastic you'll find the antenna's resonant frequency lowers slightly when it is wet, but it will return to normal when the Silastic sets.

The finished product. The wire can be seen leaving the slit at the top, making four turns around the insulation and then re-entering the slit at the bottom of the coil. The coil is enclosed in heatshrink tubing which continues down inside the BNC connector.

The graph in Fig.1 shows how my own whip antenna ended up. On two metres the VSWR is quite high on the low end, but FM walkie- talkies are seldom used below 146MHz. From 145.4MHz up the VSWR is below 2:1. On UHF the reading is nice and low, with its best point around 432MHz. It starts to climb a bit toward 440MHz, but we seldom transmit on this band above 435MHz; repeater outputs are at the high end.

The two VSWR curves cross as you can see, one going up and the other going down, at around 147.5 and 437MHz. If I were doing it again I would try to make them cross more toward the middle of the graph. But I suppose the point is really academic; on an hand-held radio the SWR's would be all over the place anyhow. What really counts is how well the antenna works.

Performance

The finished antenna has undergone a lot of testing in the most basic way — climbing up mountains and talking to people. I tried it on two HT radios, an Icom IC24AT VHF/UHF set, and an Icom Micro-2a VHF-only radio. The dual band HT has two transmit power levels, 1 watt and 0.2 watt. The smaller Micro-2 runs 1 watt and 0.1 watt — true flea-power.

Working around town from home, the whip antenna produced constantly better signal reports on both VHF and UHF, compared with the normal 'rubber duckie' antennas supplied with the radios. But from the tops of mountains and over long haul paths was where the whip really started to shine.

Around five km from Hobart city is the very prominent Chimney Pot Hill, around 500 metres high and the site of a large Telecom installation.

It is also a most interesting amateur radio spot, providing you're prepared to climb to the top on foot. From here it is sometimes possible, standing in the right place and running the highest power, to get into a two-metre repeater at Snow Hill on Tasmania's east coast. After swapping from the rubber duckie to the whip, the marginal signal improved to nearly noise free.

The most convoluted test involved sending a two-metre signal from Chimney Pot Hill up into New Norfolk in the Derwent Valley. Mount Wellington lay directly in the path, so the signal had to snake and bounce its way off the hills and up the valley. With the rubber ducky, nothing. A good readable signal with the whip.

For distance, the whip produced a two-metre contact at the 0.2 watt power level between Chimney Pot Hill and Arthur's Lake in Tasmania's Central Highlands, a distance of 110km. That represents 550km per watt on VHF.

The most difficult test of all was from

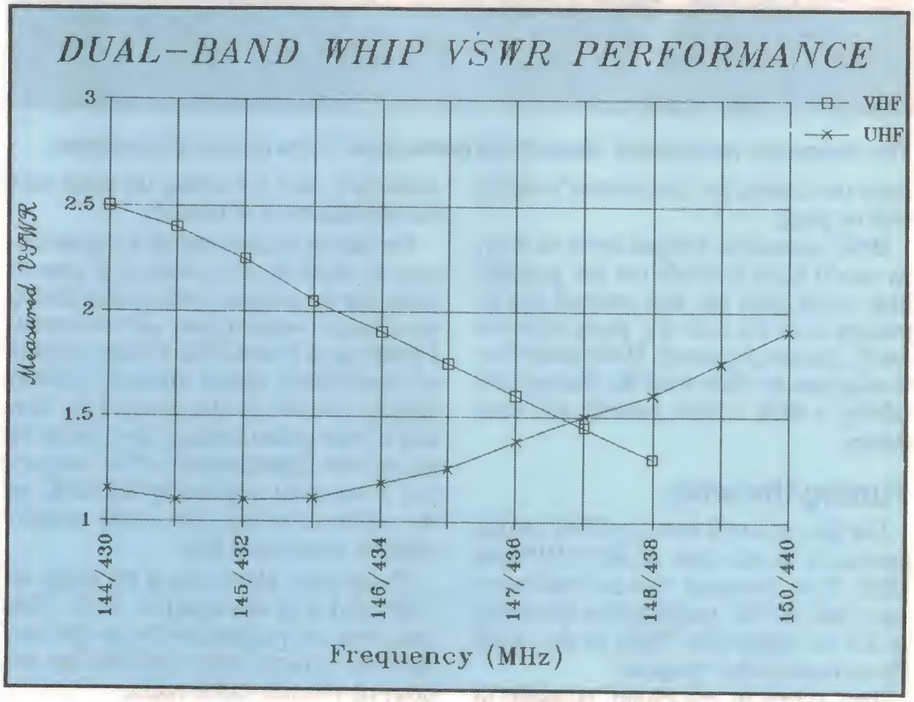


Fig.1: The VSWR performance of Tom's prototype dual-band whip. With a little further trimming, the two curves could be arranged to cross nearer the middle of the two metre band.

a beach at Port Cygnet, 65km from Hobart, over two intervening mountain ranges and into the two-metre repeater on Mt. Wellington. I've tried many times over the past few years to crack the repeater from this spot, and it's been impossible until the whip antenna came along. The signal was scruffy, and I had to climb up a tree to do it, but contact was achieved.

The general feeling on two metres was that the whip antenna running 0.2 watt produced similar results to the rubber duckie running 1.0 watt. This would suggest an improvement of around 7dB, much in keeping with the theoretical advantage of a full- sized antenna over a helical.

I didn't get to try much long-haul work on UHF, because most outlying stations don't seem to bother with UHF. There's one far- flung repeater, but it was off the air while I was doing the tests.

On receive, the whip seemed to improve things much more than 7dB, possibly because of its much larger capture area. And where it really shined was on the non-amateur bands, from 118MHz aircraft frequencies right up through the VHF and UHF commercial bands.

Such a lightweight design isn't terribly rugged; you wouldn't want to go bashing through the scrub with the whip on the radio or it would end up bent into a pretzel shape.

The trick is to carry it in a backpack or something, possibly bent to fit, and then straighten it out and put it on the radio once you reach an interesting operating spot. On top of a bare mountain the antenna stands up fine even in a 30-knot wind.

The worst test of the antenna's strength came when it was attached to the IC-24AT radio, sitting on my desk. Somebody came along and brushed against the antenna, sending it and the radio into a one-and-a-half somersault with pike, head first into the rubbish bin on the floor.

The whip was a bit of a mess after this, but some careful bending put it right again. However you wouldn't want to do such a trick too many times.

So if you want some big improvements for little money, this antenna would be worth a try. You aren't restricted to dual-band use, of course. you could make one for a VHF- or UHF- only radio, and optimize the VSWR for that band only.

You might even want to strengthen the basic design into something that could be used on top of a car. A few amateurs around Hobart are using mobile antennas of this type and their performance is excellent. ■

APPA 90 series handheld DMMs

The Taiwanese Corporation APPA Technology offers four models in its 90 series range of digital multimeters. All are neat and very sturdy and offer some very useful extra features to make them more practical. They read accurately, and offer a full range of measurements.

How often have you wondered what to do with the trailing leads of your DMM? APPA's series 90 models all provide a handy clamp on the sides near the top, to hold the probes when not in use.

The leads are the correct length to wind around the casing, still leaving them plugged into the meter. These probe holders also grip the probes to let you read the display more easily when making two-handed measurements.

Another practical aspect of the design is the versatile tilt stand built onto the back of the casing. If it is swung out to the 45° position, it will hook over any raised edge, like a cabinet door. In the 90° position, it sits up neatly on the workbench. There is even a slot to allow the meter to be hung vertically on a screw.

The probes have a groove near the tip, which makes it very easy to position them on component leads.

The APPA series 90 includes four models. Two of the four models are reviewed here, models 93 and 98. The other two models, 91 and 96, are both water-resistant.

These water-resistant models are both housed in bright yellow casings. They are cheaper than the models reviewed, but have fewer measuring ranges than their 93 and 98 counterparts. The missing ranges are capacitance and frequency, while the current, voltage and resistance ranges are very similar to those provided on the 93 and 98.

The two models reviewed both feature eight functions: DCV, ACV, DC amps, AC amps, ohms, diode and continuity test, frequency count and capacitance. In general, the scales and accuracies of the two models are very similar, but there are minor differences. Both models have an 'auto power off' function to preserve the batteries.

APPA 98

As stated above, there are some minor differences between models 93 & 98 concerning their measuring ranges and accuracy. Model 98 has no 2mA scale for either DC or AC current and no 200mV AC voltage scale. However, its 200 ohm accuracy is better at +1 count than the +4 count of model 93. Otherwise, the scales and quoted accuracy are the same for the two models.

However, for the extra $70 it costs, the model 98 does provide some quite useful enhancements. While the 3.5-digit display is smaller, with 0.5" high numbers, a 41-segment analog 'bar graph' is also provided. This is curved around the top of the numbers, rather than the more usual straight line underneath the readout. So it more closely approximates the original analog meters.

Resistance and voltage measurements are also far easier to make, as both are auto-ranging. If manual control is required instead of autoranging, a 'RANGE' button allows you to step through the various ranges, giving you the accuracy desired. Holding the button depressed for two seconds returns you to 'auto', which is displayed on the screen.

If you wish to measure an in-circuit resistance which is shunted by a semiconductor junction, a low voltage facility is provided to do this more accurately.

A 'HOLD' button allows the measurement to be frozen on the readout, while a '-MEM' key stores the two least significant figures to allow comparative measurements. When the '-MEM' key is active, these stored two figures are subtracted from all the following inputs. This operation mode is very useful when lead length resistance would cause measurement errors, or when you want only to measure voltage or current deviations.

The 98 model also features auto power off, but after 30 minutes instead of 15, as well as the continuity and diode tester. When checking diodes, the actual voltage is displayed, and not just '0' or '1' for short and open circuits as with the 93 model.

APPA 93

The distinguishing feature of model 93 is its very large, 0.8" high, digits on the LCD readout. Such large numbers are very easy to read, even from quite a distance away.

These are the measurement ranges provided on the model 93.

DC voltage has five ranges: 200mV, 2V, 20V, 200V and 1000V at 0.5% +1 count accuracy; AC accuracy is 1.25% +4 counts (40Hz-500Hz) for the same five ranges except the top range is 750V AC.

Current ranges for both DC and AC are 200uA, 2mA, 20mA, 200mA, 2A and a high 20A (for a maximum of 30 seconds). DC accuracy up to 200mA is 1% +1 count, with AC 1.5% +3 counts. The higher 2A & 20A scales are 2% +3 counts (DC) and 2.5% +4 counts (AC).

Resistance has 6 ranges: 200 ohm, 2k, 20k, 200k, 2M and 20M. Accuracy is 0.75% +4 counts on the 200 ohm scale, 0.75% + 1 count on all other ranges except the 20M, which is 1.5% +5 counts.

Likewise, the capacitance has 6 ranges from 2nF-20uF, each range being ten times the previous. Accuracy is quoted at 2% +4 counts.

Frequency (1% +3 counts accuracy) is measured on 2kHz, 20kHz and 200kHz ranges.

An audible continuity buzzer is built into the diode tester. It emits a piercing sound if the resistance is less than 50 ohms. Diode checking is done by

measuring the forward voltage drop. Normally it is between 0.5V and 0.9V. If the diode is defective, a short circuit shows 0', while a '1' is displayed for non-conductance.

The 'auto power off' feature turns off the display after approximately 15 minutes.

Inside the case

Both models have very similar construction. Three screws hold the front and back of the sturdy case together. Once they are removed, the innards slide out like a rigid sandwich. The components are mounted on two printed circuit boards which are connected together with plugs. The rotary selection switch is seated between the two layers. This switch looks sturdy and clicks firmly into each of its switching positions.

Summary

When we checked the accuracy of measurement for both meters, we found that all our readings were within the quoted accuracy when we included the gating error count. Indeed, most measurements were well within the stated accuracy.

Our test references included 10 resistors of varying sizes, five capacitors, as well as one frequency and several DC and AC voltages.

One fault we found with the meters concerns the probe holders. There is a groove which holds the probe very firmly in the storage position, but, unfortunately, it is not duplicated in the measurement position.

When measuring, the probe is quite secure provided that pressure is only applied by pushing forward with the meter. If you lean the probe onto the component being tested, it tends to push away from the holder.

Also, we found some confusion when using the '-MEM' button for comparative readings. For small resistors, it is recommended that you use the '-MEM' button to eliminate the lead resistance and manually select the lowest resistance range (200 ohms) to achieve the most accurate reading. We found that this worked very well. Our test leads showed a resistance of 0.4 ohms, so the '-MEM' facility was used to remove this error from other resistance readings. But when we measured a voltage of 12.55V, and pressed the '-MEM' button, a reading of 12.00 was displayed. This meant that a 0.01V drop showed as 11.99V, while a rise of 0.01V was displayed as 12.01V. This occurred because only two figures (the least two significant) are stored and not the entire original reading. Since we were only interested in the voltage variation, the displaying of the '12' was confusing.

The '-MEM' function really only works on 'manual' selection, because every time the 'auto' function attempts to change the range for resistance and voltage, it cancels the stored value in '-MEM' register. Merely lifting the probe frequently does this.

A very obvious feature of both the meters tested is that they are extremely solid little units with very strong casings. It is claimed that they can be dropped onto concrete from 1.5m and be protected by their thick wall design and shock mounting — we didn't check out this claim!

The meters are very easy to use, and easy to read, especially the large digits of the 93 model. Model 98's curved analog bar graph works well, giving a good general indication of the size of the readings.

Including tax, APPA 93 sells for $142.80 and APPA 98 for $214.80. These seem reasonable prices for the models we tested.

For further information, contact Guy Wilson, Geoff-Wood Electronics, 229 Burns Bay Rd, Lane Cove 2066; phone (02) 428 4111 (P.M.) ■

For the newcomer:

The basics of Transformers

Generally you don't go very far in electronics without coming across a transformer of one kind or another. Here's an introduction to the way these important components work...

by DAVID BOTTO

A transformer in its simplest form consists of two insulated coils of wire magnetically coupled together, so that alternating current supplied to one coil causes an AC voltage to be induced by magnetic coupling into the other coil (see Fig.1).

In order to properly grasp the operating principles of the transformer, it is necessary first to have an understanding of the terms *self-inductance* and *mutual inductance*.

As regular readers of *Electronics Australia* will know, when a current of electricity flows through a conductor an electromagnetic field is generated. Fig.(2) illustrates this. The magnetic field is strongest at the surface of the conductor.

If two such conductors run parallel to one another (with the current in both moving in the same direction), the magnetic field will be as in Fig.3.

Forming a wire carrying an electric current into a loop causes the magnetic fields to appear as in Fig.4. Since a coil is just a series of continuous loops, the magnetic fields of a coil of wire carrying a direct current (DC) will be as shown in Fig.5. Notice that the magnetic lines of force leave the coil at one end (the north pole) and enter again at the other end (the south pole).

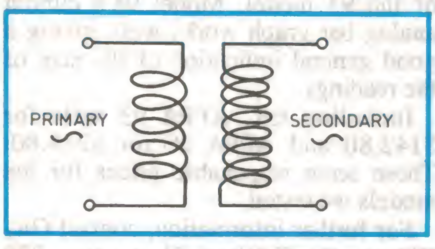


***Fig.1:** Essentially, a transformer consists of two insulated coils magnetically coupled together.*

This field becomes much stronger when the coil is wound upon an iron core (Fig.6). A more effective magnetic path is provided for the lines of force and many more lines of force are produced. This greatly increases the intensity of the magnetic field.

Such a coil acts as an *electromagnet*, and is called a solenoid. (From the Greek term for a pipe-like coil).

If the DC supply voltage is suddenly increased by an adjustment of variable resistor VR1 (Fig.6), the current flowing through the coil does not immediately increase by the amount you might expect according to Ohm's Law. The reason for this is that as the current tries to increase, it is found that there is an electro-motive force (EMF) produced by the coil itself.

This force tries to prevent any increase in the current flowing through the coil and is known as the 'back electromotive force of self-induction.' It's usually referred to as *back EMF*. The back EMF (a voltage) disappears when the current and magnetic field reach their peak values.

When the battery voltage is quickly *decreased* by resistor VR1 or cut off altogether by switch SW1, the energy stored in the magnetic field must be decreased. This change again produces an EMF, which tries to prevent any decrease in electrical current through the circuit. Its effect is to slow down the fall in current until the magnetic field energy has finally been absorbed, partly as heat energy by the wire forming the coil.

Knowing this we can define self-inductance (or simply *inductance*, as it's usually referred to) as the ability of a conductor or coil to oppose any increase or decrease in the current flowing through it.

(WARNING: Be careful when disconnecting any solenoid from a DC supply. The back EMF built up can give you a nasty shock!)

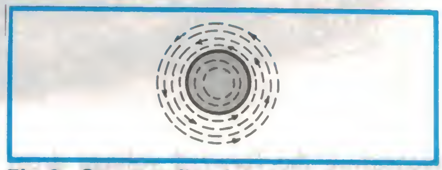


***Fig.2:** Current flowing in a conductor produces a magnetic field, which is strongest at the surface.*

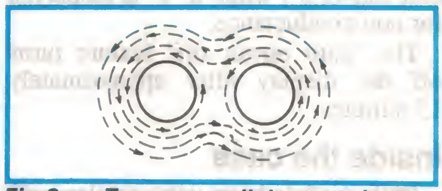


***Fig.3:** Two parallel conductors carrying the same current develop a field as shown.*

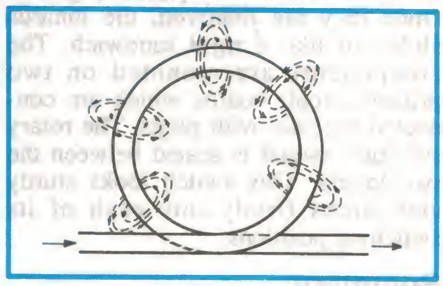
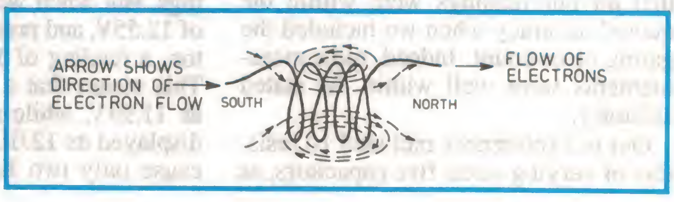


***Fig.4:** Forming a current-carrying conductor into a loop changes the field as shown here.*

***Fig.5:** A number of loops grouped together form a solenoid, with a field like a bar magnet.*



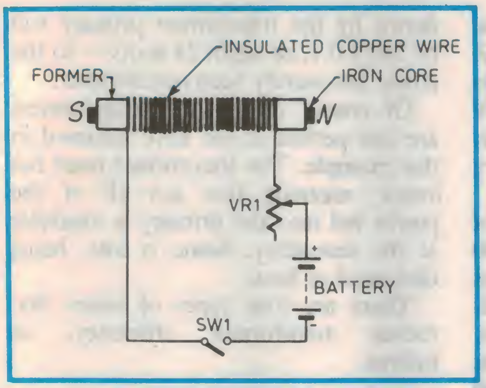


Fig.6: With an iron core placed inside the solenoid coil, the magnetic field becomes much stronger.

The Henry

The unit of inductance is called the *Henry*, in honour of an early pioneer. A coil has a self-inductance of one henry when the EMF induced in it is one volt when the current changes by one amp in one second.

A *millihenry* (mH) is one thousandth of a henry, and a *microhenry* (uH) is one millionth of a henry. These values are more often found in practical circuitry.

Mutual inductance

In Fig.7, when switch SW1 is closed a direct current flows through the primary coil (which we'll now call the primary winding). As a result a magnetic field or *flux* is produced, and a proportion of this field passes through the other (secondary) winding. It's conventional to say that some of the primary coil's 'magnetic lines of force' pass through the secondary winding.

The number of these lines of flux passing through the secondary depend upon (a) the amount of current flowing through the primary winding, (b) the shape and size of the primary and secondary windings, and (c) the position of the primary winding relative to the secondary winding. This linkage of flux is known as the *mutual flux linkage* between the two windings.

As long as switch SW1 is kept closed, no current will be measured by the centre zero meter. However if SW1 is opened, current will momentary flow through the secondary winding and the meter will be deflected in one direction. Then when SW1 is closed again, current flow will occur in the opposite direction and the meter will be deflected the other way.

This phenomenon is known as *electromagnetic induction*, and the current flowing through the secondary winding is an induced current – resulting from a voltage induced in the secondary winding whenever the magnetic flux changes. The voltage across secondary connections C and D is called an *induced EMF*.

Here we learn an important rule. Voltage will only be induced into the secondary winding of a transformer when the primary current is rising or falling.

This effect was first discovered by Michael Faraday. If the meter – which acts as a load – was disconnected the induced EMF would still be present at terminals C and D. However there would be no current flow through the secondary winding. Current only flows through the secondary winding when a load is connected.

The direction of the induced current and the polarity of the induced EMF are reversed each time switch SW1 is opened and then closed. The faster SW1 is switched on and off, the greater the magnitude of the induced EMF.

Two windings of a transformer are defined as having a *mutual inductance* of one henry if the EMF induced in the secondary winding is one volt when the current in the primary winding is changing at the rate of one ampere per second.

It is the effect of mutual inductance that makes possible the operation of every type of transformer.

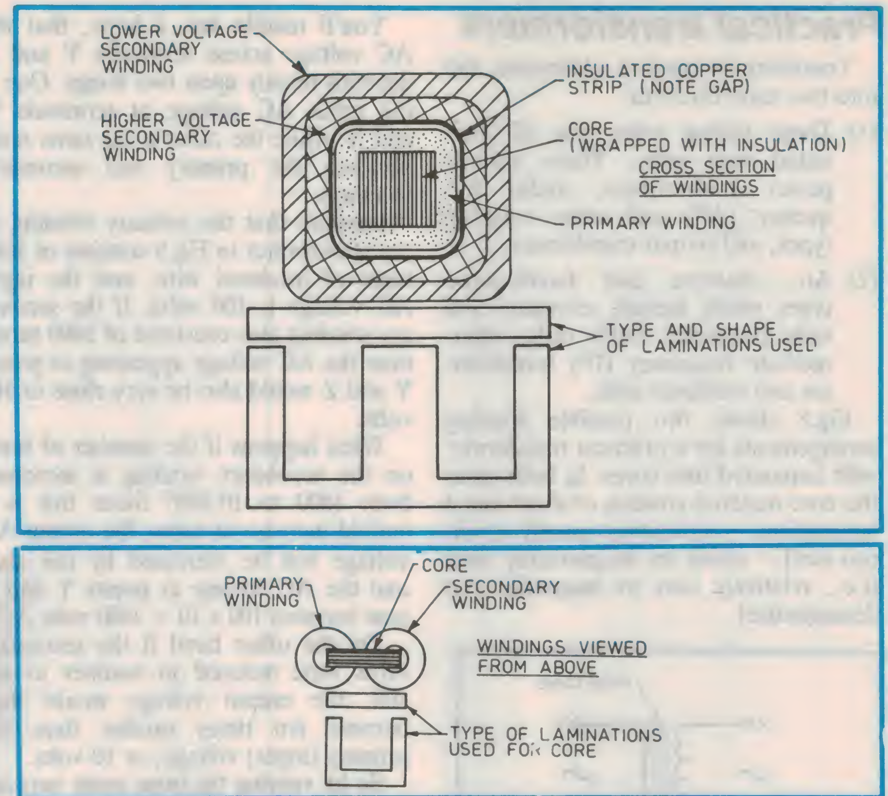


Fig.8: The two main kinds of transformer construction. That at top uses 'E' and 'I' shaped iron laminations, with primary over secondary, while that above uses 'C' and 'I' laminations and two separate windings.

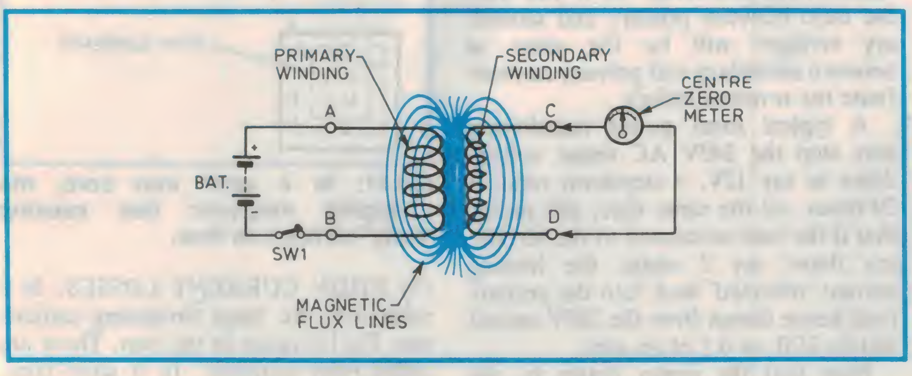


Fig.7: When SW1 is closed, current flows through the primary winding, and the resulting magnetic field passes through the secondary.

Practical transformers

Transformers used in electronics fall into two main divisions:

(1) Those having some type of laminated iron core. These include power transformers, audio frequency (AF) and stage coupling types, and output transformers.

(2) Air, dustcore and ferrite-cored types which include television and radio-frequency (RF) coils, intermediate frequency (IF) transformers and oscillator coils.

Fig.8 shows two possible winding arrangements for a practical transformer with laminated iron cores. In both cases the core material consists of sheet metal laminations – nowadays usually a silicon steel – which are magnetically 'soft' (i.e., relatively easy to magnetise and demagnetise).

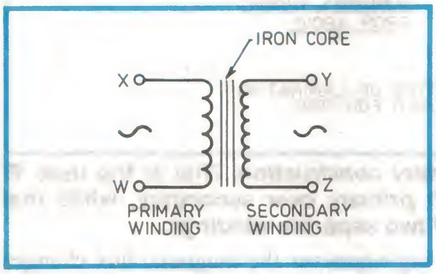


Fig.9: When AC is fed into a transformer's primary, an AC voltage is induced in the secondary.

Fig.9 shows the schematic of a transformer designed to operate at low frequencies – for example the 50Hz sinewave mains frequency. Instead of a direct current an alternating current or AC is fed into the primary winding.

This causes current to flow through the primary winding, first in one direction and then in the other. Since this current is continually changing in value, an AC voltage is induced into the secondary winding. At the same time an EMF is induced in the primary winding itself, as a result of its self inductance.

In a properly constructed transformer, almost all the magnetic flux produced by the current flowing through the primary winding will intersect with every turn of the secondary winding.

Because of this the EMF induced in every turn of the primary winding will also be induced into every turn of the secondary winding. In other words if one tenth of a volt is induced into each turn of the primary, one tenth of a volt will also be induced into each turn of the secondary. (In practice there will be slight losses).

You'll readily see, I hope, that the AC voltage across terminals Y and Z depends mainly upon two things. One is the input AC voltage at terminals W and X, while the other is the *turns ratio* between the primary and secondary windings.

Suppose that the primary winding of the transformer in Fig.9 consists of 1000 turns of insulated wire, and the input AC voltage is 100 volts. If the secondary winding also consisted of 1000 turns, then the AC voltage appearing at points Y and Z would also be very close to 100 volts.

What happens if the number of turns on the secondary winding is increased from 1000 to 10,000? Since this is a tenfold increase in turns, the output AC voltage will be increased by ten also, and the AC voltage at points Y and Z now becomes 100 x 10 = 1000 volts AC.

On the other hand if the secondary turns were *reduced* in number to say 100, the output voltage would then become ten times smaller than the primary (input) voltage, or 10 volts.

So by varying the *turns ratio* between the primary and secondary windings, we can produce any desired AC output voltage.

A transformer therefore has the ability to *transform* AC voltage – up to higher or down to lower values. This does not mean power is being produced from nowhere, however. The higher the voltage 'step-up', the lower the current available from the secondary winding. And conversely when we use the transformer to step the voltage down, the permissible current that can be drawn from the secondary increases.

In fact as well as transforming the AC voltage level up and down, the transformer also transforms the current levels – but in the inverse ratio. So if the voltage is stepped up by three times, for example, the current will be effectively stepped down by the same factor. And vice-versa. Or if you like, the ratio between primary and secondary *voltages* will be the same as between secondary and primary *currents* (note the reversed order).

A typical small power transformer may step the 240V AC mains voltage down to say 12V, a stepdown ratio of 20 times. At the same time, this means that if the load connected to the secondary draws say 2 amps, the loading current 'reflected' back into the primary (and hence drawn from the 240V mains) will be 2/20, or 0.1 of an amp.

Note that the power drawn by the load connected to the secondary is 12 x 2, or 24 watts. Similarly the power drawn by the transformer primary will be 240 x 0.1, or again 24 watts – so the power has merely been *transformed*.

Of course in practice, transformers are not perfect as we have assumed in this example. The transformer itself has *losses*, meaning that not all of the power fed into the primary is available at the secondary. Some is lost, being dissipated as heat.

There are four types of losses that reduce transformer efficiency, as follows.

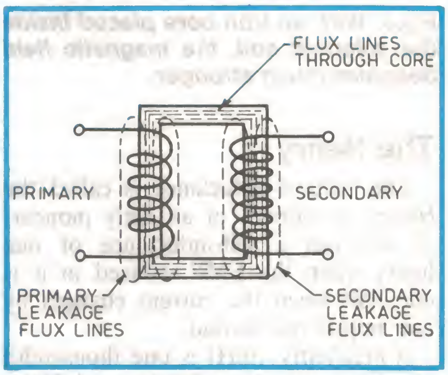


Fig.10: Even though an iron core is coupling two windings, each will have its own 'leakage' field.

(1) MAGNETIC LEAKAGE: Some of the flux lines produced by the primary winding current (see Fig.10) 'miss' the secondary winding(s) and take shorter paths. The result is that the voltage output of the transformer is slightly reduced. The primary flux that *doesn't* pass through the secondary is known as *primary leakage flux*. To minimise this effect, the transformer coils are often wound 'on top' of each other (Fig.8).

(2) RESISTIVE COPPER LOSSES: The resistance of the insulated copper wire used in the windings causes a slight drop in the transformer output voltage. This loss is minimised by the careful selection of the copper wire.

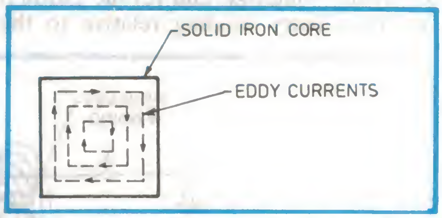


Fig.11: In a solid iron core, the changing magnetic flux causing 'eddy' currents to flow.

(3) EDDY CURRENT LOSSES: In a solid iron core, large circulating currents (see Fig.11) occur in the iron. These are called *eddy currents*. In a solid core, eddy currents heat up the core, wasting energy and possibly damaging the trans-

former insulation.

Eddy current effects are overcome by using laminated strips of iron insulated from each other by varnish, shellac or some other kind of extremely thin insulating material. This forces the eddy currents to travel in narrow high resistance paths, which keeps them down to a tiny amount and makes their effect minimal (Fig.12).

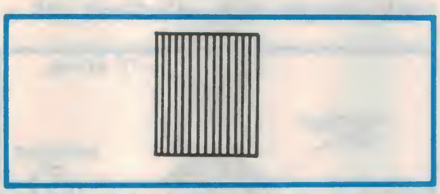


Fig.12: Making the core from a stack of thin insulated laminations prevents eddy currents from flowing.

(4) HYSTERESIS LOSSES: As the AC goes through each complete cycle, the ferromagnetic core of the transformer goes through a cycle of magnetisation and demagnetisation.

As the intensity of the AC signal input increases and decreases, so the strength of the magnetic flux increases or fades away. When the AC signal passes through its zero value, some magnetism is still retained by the iron core of the transformer. This is illustrated in Fig.13.

When the magnetising current and force are increasing (curve a to x), the magnetising effect follows the curve a to b initially, but on all later occasions the curve d-a. When the current decreases the magnetism follows the curve b to c.

At point c the applied current and magnetising force have dropped to zero, but as you can see there is still a residual or *remanent* magnetism (a-c on the vertical axis). This remanent magnetism is not reduced to zero until the AC input reverses in polarity to point e. Point d is the corresponding point on the return half-cycle.

What this means is that extra energy must effectively be used to 'drag' the magnetic core material through the magnetic cycle – magnetising it first in one direction, then the other, then back to the first direction and so on.

Since the word *hysteresis* means 'lagging behind', it is a particularly apt term used to describe this type of loss. The energy lost appears as heat in the core. Such losses increase as the AC frequency increases.

To minimise hysteresis losses, either pure iron or special iron alloys are used for transformer cores. One such alloy consists of pure iron with a small amount of silicon added.

Power transformers

A *power* or 'mains' transformer is designed to be energised by the AC mains supply. On top of the primary winding is wrapped an insulated piece of flat copper strip forming an open loop (Fig.8), normally connected to earth. This prevents electrostatic coupling occurring between the primary and secondary windings.

The schematic of a mains transformer of the type used in a typical Video Cassette Recorder is shown in figure (14). You'll see it has several secondary windings, producing various AC voltages. The number of turns on the primary winding depends on the frequency of the mains supply (usually 50Hz), the core area, and the maximum AC flux density.

We'll assume that the primary winding in this particular transformer consists of 1200 turns of insulated copper wire. For a 240 volt AC input, this means there are five turns of wire for every volt of the input supply (1200 divided by 240 = 5). This is generally expressed as 'five turns per volt'.

Knowing the turns per volt of the primary, it's easy to calculate the number of turns required for each of the secondary windings. The 16 volt winding needs 16 x 5 = 80 turns; the 3 volt winding 3 x 5 = 15 turns. Similarly the 100 volt winding needs 100 x 5 = 500 turns, while the 5 volt winding needs 5 x 5 = 25 turns.

Auto transformers

Fig.15 shows an AC mains powered *auto transformer*, of the type used in some TV receivers. Its single winding is 'tapped' to produce a 100 volt AC output. In effect, the 100V secondary winding is not separate from the primary, but forms part of it.

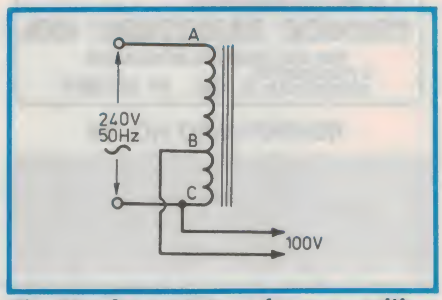


Fig.15: An autotransformer, with a single tapped winding instead of separate windings.

Notice that in this case, the output is not isolated from the AC line.

The turns ratio for an auto transformer is worked out in exactly the same way as for a normal transformer with separate windings. If the auto transformer primary has a total of 1200 turns of wire, for 240V input, the number of turns between points b and c for 100V output will be 500.

AF transformers

Audio frequency interstage (driver transformers), popular in the days of

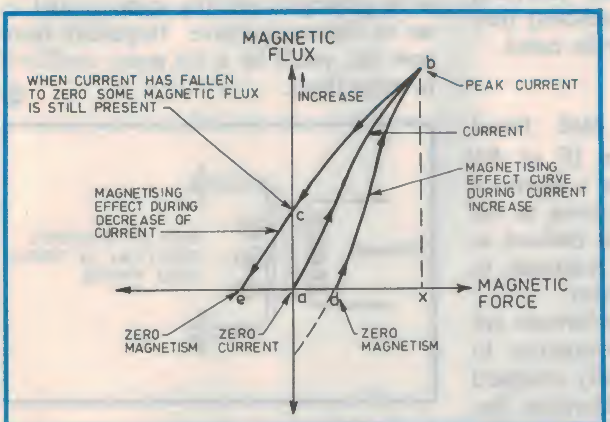


Fig.13: Because the iron core retains some magnetism and 'lags' behind the applied magnetising force, some of the incoming energy is lost – 'hysteresis loss'.

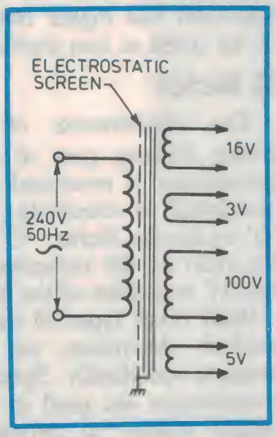


Fig.14: A power transformer used in a typical VCR.

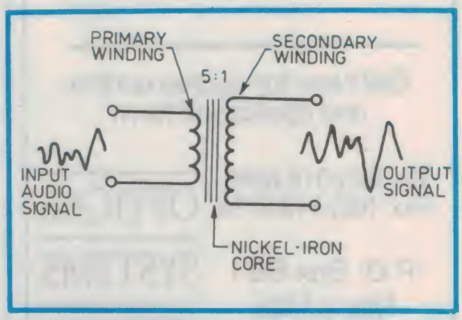


Fig.16: In the days of thermionic valves, transformers were used for inter-stage audio coupling.

valve equipment, are rarely seen in modern equipment (Fig.16).

An audio driver transformer is similar in construction to that of a power transformer but smaller in size. It's designed to handle signals over a wide range of audio frequencies, and to keep distortion of the output signal to a minimum.

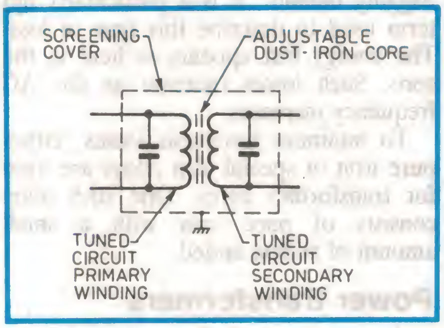


Fig.17: Transformers with tuned windings and iron dust or ferrite cores are used for RF and IF coupling.

The core laminations are made from nickel-iron or other special alloys.

Hefty audio output transformers are often found in large public address amplifiers. They produce a 70 volt or 100 volt audio line signal which can 'drive' a fair number of loudspeakers.

IF, RF transformers

An IF (intermediate frequency transformer) is designed to amplify only one fixed frequency of a certain bandwidth. To do this efficiently both the primary and secondary windings are arranged to form part of tuned circuits with fixed capacitors, set to the desired frequency by means of adjustable iron dust or ferrite core(s) – see Fig.17.

RF or 'radio frequency' transformers (although the term RF also embraces television and higher frequencies) may be air cored or iron dust/ferrite cored.

Q factor

The effectiveness of each tuned circuit forming part of an IF or RF transformer is measured as a figure of 'goodness' or selectivity, known as the 'Q' or *quality factor*. 'Q' is defined as the ratio of the inductive reactance to the AC resistance of the circuit.

Many other types of transformers are used in electronics, too numerous to mention specifically. Specially designed transformers are used in television line output stages, to produce extremely high voltages for the final accelerating electrode of the cathode-ray tube (CRT).

An inductance wound on a core (usually of ferrous material) shaped in the form of a ring or *toroid* has an extremely small external (leakage) magnetic flux and a high concentration of magnetic flux within the toroid. Fig.18 shows a specialised kind of toroidal transformer being used to measure the RF current in a transmitter's aerial circuit. Here the 'primary' winding is a single straight wire, effectively half a

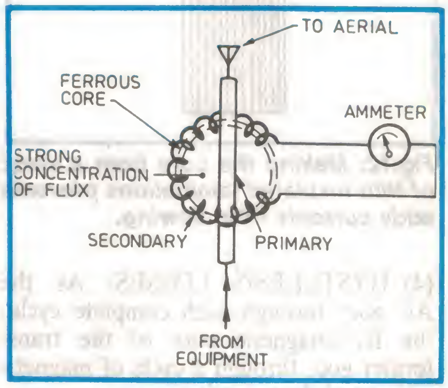


Fig.18: A toroidal core and winding can be used to measure current in a single wire – here at radio frequencies.

single turn, while the secondary is a larger number of turns would on the toroidal coil. So the transformer steps UP in voltage, from primary to secondary, but DOWN in current.

You may come across the term *bifilar* in connection with transformers or their windings. This simply means transformer windings that are wound as one, so that two ends (B in Fig.19) are always at the same potential. The two windings are identical and wound in the same direction.

Although the many types of transformers you'll encounter may differ widely in construction, their basic operating principles are the same – and as we've discussed above. Hopefully from now on, you'll be a lot more confident in using them.

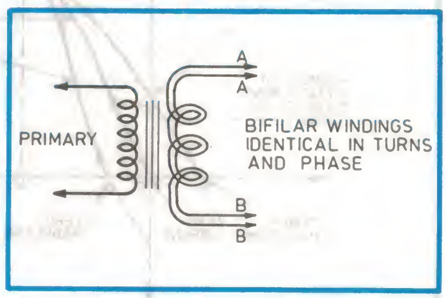


Fig.19: In some cases, a pair of windings may be wound together in 'bifilar' fashion, to ensure that they are identical.

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Modes:	CH1, CH2 (Norm/Inv), Alt., Chop, Add	Mains:	240V or 220V or 110V
Horizontal Deflection:		Battery:	6 x 'C' cells
Bandwidth:	2MHz, -3dB	**General**	
Timebase		CRT:	40mm x 30mm, P45
Sweep Times:	0.5s to 0.1µs	Size:	219x240x98 mm (WxDxH)
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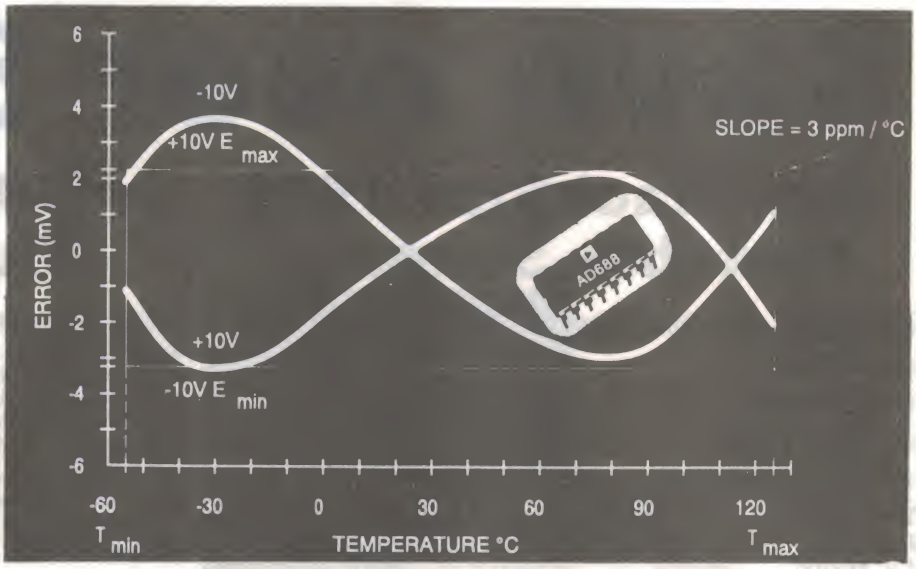
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Dual bipolar voltage reference

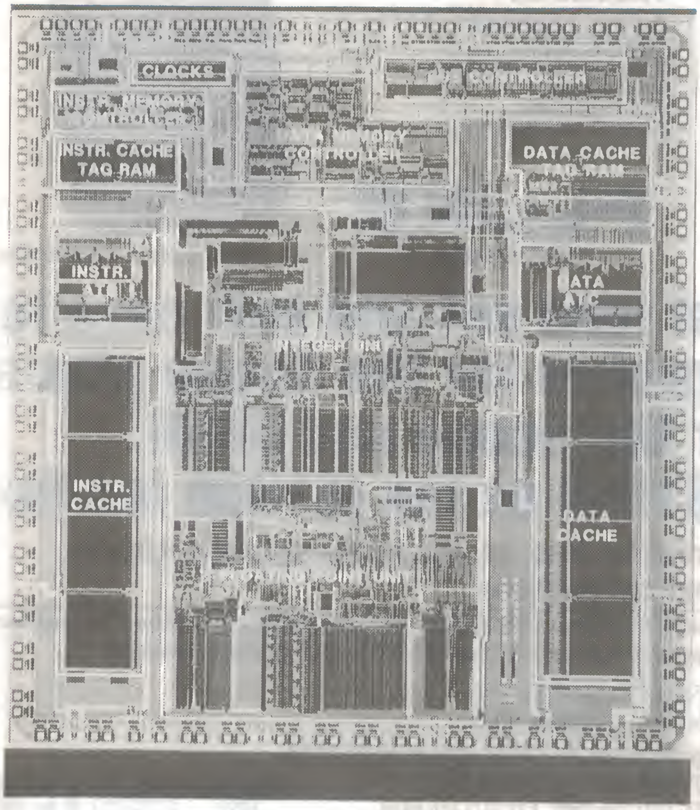
Analog Devices' AD688 is a precision monolithic ±10V reference. With a maximum tracking error of 1.5mV, initial error of 2.0mV and temperature drift of only 1.5ppm/°C, the AD688 absolute accuracy performance matches that available from more expensive, complex hybrid devices. Applications include robotic, avionic and instrumentation designs, as well as 12 to 16-bit data acquisition systems.

The AD688 offers 12-bit absolute accuracy without any user adjustments or trims. Force and sense connections, also known as Kelvin connections, correct for the effects of voltage drops in circuit wires. Load current and connection resistance can result in a voltage error at the load; Kelvin connections overcome this problem by forcing the reference output of the AD688 to a value that precisely compensates for the voltage error.



The AD688's performance is achieved by laser trimming high stability thin-film resistors to correct for drift. The reference cell consists of a proprietary design, ion-implanted buried Zener-diode; also included are three low-drift amplifiers to facilitate Kelvin connections.

For more information, circle 271 on the Reader Services Coupon or contact NSD Australia, PO Box 264, Box Hill 3128; phone (03) 890 0970.



68040 microprocessor

The Microprocessor and Memory Technologies Group of Motorola, has announced initial volume shipments of the production version of its 68040 (040) microprocessor.

More than 100 companies have sampled early versions of the 040. A total of 36 computer system and board manufacturers, including Apple, Hewlett-Packard/Apollo, NCR, Next and Unisys have announced their intention to use the microprocessor to power the future products.

The 68040 embodies a complete redesign of the 68000 family architecture, helping it deliver from three to ten times the performance of the 68030, while remaining 100% software compatible with all other 68000 family members.

Executing 20 million instructions per second (MIPS), the 040 has the highest throughput of any available mainstream microprocessor, performing up to 14 operations simultaneously.

It outperforms both complex and reduced instruction set computing (CISC and RISC) microprocessors like the Intel 80486 and Sun Microsystems' sparc.

The 68040 is the most advanced single chip microprocessor ever built. It has 1.2 million transistors, almost four times the number in the 68030.

Fabricated with Motorola's 0.8-micron high performance complementary metal oxide semiconductor (HCMOS) process, the 040 integrates an integer unit, a floating point unit, two memory management units and two 4 kilobyte cache memories — one for data and one for instructions.

Latest TMS370 microcontroller

New additions to the TMS370 family of 8-bit configurable micro-controllers further increase its design flexibility by integrating a programmable timing coprocessor, EEPROM, and an analog-to-digital converter on the same device.

To meet real-time control requirements and increase total system performance, three standard TMS370 devices will feature TI's new Programmable Acquisition and Control Timer Module (PACT). PACT is a software definable timing and state machine that can be directly configured to service external events in a real-time control system, instead of burdening the host CPU with this task.

TI developed the PACT module at its French design centre in Nice to meet new, more stringent 1992 European car emission standards.

By using a single PACT-based device to control engine and instrumentation functions, car designers will be able to reduce their total system cost and size and increase reliability.

Ignition-timing and fuel-injection applications are the first applications planned to use the PACT module with its six captures, eight timer-controlled outputs with pulse width modulation.

IBM mainframe speed records

IBM scientists announced several world speed records for the kinds of circuits used in high-speed mainframe computers. The announcements were made recently in San Francisco. The records promise a long life for silicon as a computer chip material for the fastest computers.

The records were set using 'bipolar' transistors, so called because they use both positively and negatively charged particles to carry electrical current.

The experimental transistors used had thin 'control' layers that are just 60 micrometres thick. Switching speed or gate delay is the time it takes for electrical current to travel through a standard benchmark circuit, which is an emitter coupled logic circuit.

The three IBM switching records were: NPN transistor, 25 picoseconds; PNP transistor, 35 picoseconds; NPN silicon-germanium transistor which operates at 97GHz when cooled to -184°C.

The first two records show that the two complementary types can operate in the same speed range which opens up the possibility of new high-speed, power-conserving bipolar circuits. The third record promises possible superfast, supercooled computers using bipolar transistors.

4-Mbit DRAM

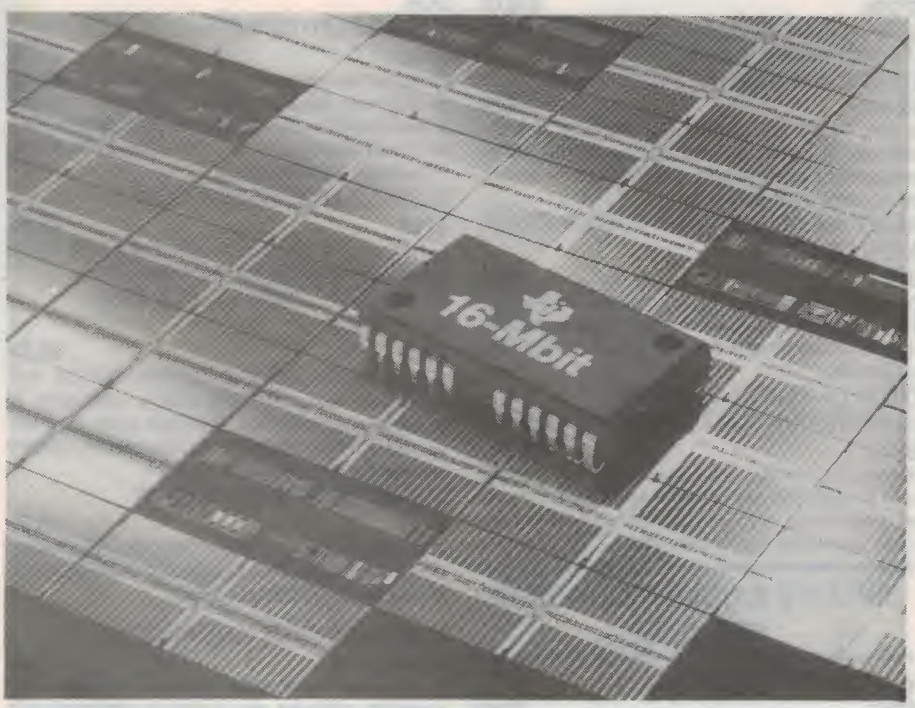
Texas Instruments has begun production shipments of 4-megabit dynamic random access memories (DRAMs) and is ramping up for volume production. TI's high density 4-Mbit DRAM employs state-of the-art 'Enhanced Performance Implanted' CMOS process technology for high performance, high reliability and low power at a competitive price.

TI's high-density 4-Mbit DRAMs will combine with the latest generation 32-bit microprocessors to enable high-performance computer systems ranging from engineering workstations to personal computers. Other emerging applications include HDTV, digital copiers, fax machines and scanners.

TI's innovative DRAM trench-cell capacitor improves reliability. The trench storage cell approach, with its three-dimension capacitor, permits increased capacitance within a smaller area and improves user reliability by reducing sensitivity to alpha particles, thus improving the soft error rate, common to all devices with submicron features.

More than 2.5 billion 4-Mbit units are expected to be shipped by industry during the next five years, with fewer than 20 million units shipped to date.

Also, TI has begun limited sampling of two versions of its 16-Mbit DRAMs and is one of the first manufacturers to deliver fully functional 16-Mbit devices that use a production design. Units produced using the first mask set were fully functional and met all design specifications without repair.



SMD package

Philips' SOT223 package is fast becoming a standard for many medium-power SMD applications. It can dissipate at least 1W on standard printed-circuit boards and up to 2W on ceramic substrates.

As well as providing all the benefits of existing SMD packages, the SOT223 can also handle dice up to 2.5mm square.

Philips has available general purpose and wideband transistors, Schottky rectifiers and triacs and thyristors, all in the new package.

Applications for devices mounted in the SOT223 include small motor control, displays, printer hammers, SMPS drivers, actuators, fuel injection drivers, data-bus interfaces and disk-drive controllers.

For more information, circle 272 on the Reader Services Coupon or contact Philips Components, 34 Waterloo Rd, North Ryde 2113; phone (02) 805 4455. ■

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Mains power supplies are an essential part of many electronic projects. This book gives a number of power supply designs, Including simple unstabilised types, fixed voltage regulated types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low-voltage types for semiconductor circuits.

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This book covers in detail the construction of a wide range of audio projects. The text has been divided into the following main sections: Pre-amplifiers and Mixers, Power Amplifiers, Tone Controls and Matching, Miscellaneous Projects.

All the projects are fairly simple to build and designed to assist the newcomer to the hobby.

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This book will enable a relative beginner to build, with the minimum of difficulty and at reasonably low cost a worthwhile mono-phonic synthesiser, and also learn a great deal about electronic music synthesis in the process.

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As a definitive introduction to the subject this book is presented on two levels. For the absolute beginner with no previous knowledge, the story is told as simply as it can be in the main text.

For the professional engineer, electronics enthusiast, student or others with technical backgrounds, there are numerous appendices backing up the main text with additional technical and scientific details, formulae, calculations and tables etc.

FAULT-FINDING

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
BP110 **$8.50**

We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

AUDIO AMPLIFIER FAULT-FINDING CHART
BP120 **$4.00**

This chart will help the reader to trace most common faults that might occur in audio amplifiers. Across the top of the chart are two "starting" rectangles, vis Low/Distorted Sound Reproduction and No Sound Reproduction; after selecting the most appropriate one of these, the reader simply follows the arrows and carries out the suggested checks until the fault in located and rectified.

GETTING THE MOST FROM YOUR MULTIMETER
BP239 **$11.00**

It is amazing just what you can check and test with a simple multimeter if you know what you are doing. This book tells the story, covering the basics and relative merits of analogue and digital instruments,component checking and dealing with circuit testing.

MORE ADV. USES OF THE MULTIMETER
BP265 **$12.00**

A sequel to book BP239 showing the reader some more advanced and unusual applications of that humble test instrument - the simple multimeter.

HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT
BP267 **$12.00**

Just as the title says, this book shows the hobbyist how to effectively use a number of pieces of electronic test equipment including the oscilloscope.

To order, simply fill in the coupon, remembering to included the code numbers and $5.00 postage and handling. If the coupon is missing, write down the names, code numbers and prices of the books you require. Include your name, address, ph number, plus cheque, money order or credit card details (card type, card number, expiry date and signature) and send it all to Federal Publishing, Freepost No.3, P.O.Box 199 Alexandria, NSW 2015. Don't forget to sign all orders.

NEW PRODUCTS

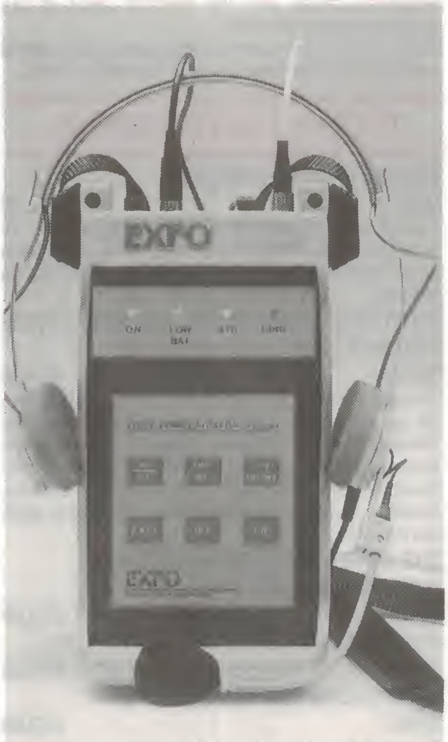
Fibre optic 'talk set'

The new VCS-20A full-duplex fibre optic 'talk set' from Exfo Engineering received the prestigious best product of the year award during the Canadian High Technology week, held in Toronto, Ontario.

The VCS-20A allows installation crews to talk over one fibre in full-duplex over a distance of up to 120km. It also features the following functions in the same unit: stable light source for attenuation testing, 2kHz tone transmission for active fibre detector and 2kHz tone detector.

It is designed for the most severe field uses and offers an innovative three way powering which allows the unit to automatically select its power from the ACT line, built-in NiCad batteries or, if its NiCads are too low, from disposable 9V DC alkalines.

For further information circle 241 on the reader service coupon or contact Exfo E.O. Engineering, 352 St-Sacrement Avenue, Quebe City, QC Canada.



Colour vacuum fluorescent displays

The FLIP 36Xo-14-020 and 36XI-16-020 are vacuum fluorescent alphanumeric display modules arranged as one line of 20 characters. The bright blue-green colour is filterable to blue, green, aqua or yellow.

The characters are formed using a 15mm or 9mm 5 x 7 dot matrix, which allows easy viewing from a distance and over a wide viewing angle. It also allows the representation of both upper and lower case characters, numerals and punctuation.

The full 96-character ASCII font can be displayed, and it can be altered to include the characters necessary to produce ECMA General European, German or Scandinavian fonts, all under software control.

All control, refresh and display functions of the modules are executed by a dedicated on-board microprocessor.

A miniature on-board DC to DC voltage converter provides all the voltages necessary to light the vacuum fluorescent display while allowing the FLIP 1 x 20 modules to operate from a single 5V power supply.

Data interfacing is via an 8-bit bi-directional TTL-ASCII data bus or serial input, using 1200 baud jumper-selectable TTL or RS-232 serial data formatted as an 11-bit word. By use of simple commands or ASCII control codes, data can be selectively written to or read from any character location.

For more information circle 246 on the reader service coupon or contact Davidson Pty Ltd, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

High performance data cable

National cable and component distributor ACME Electronics has announced the release of high performance twisted pair data cables, manufactured by Belden Wire & Cable in the USA.

These cables may be used in any computer application which supports twisted pair cabling. They are available in four twisted pair configurations, both shielded and unshielded. Other features of the cable are data speeds of 16Mbps to 100Mbps, nominal capacitance of 42.7pf/m and computer hardware independence.

The cable meets or exceeds IEEE 10base T specifications, and supports all LAN topologies including Star, Bus, Ring and Tree.

For further information circle 242 on the reader services coupon or contact Acme Electronics, PO Box 264, Box Hill 3128; phone (03) 890 0900.

Universal VME bus interface

Phoenix Contact of West Germany has released the FLKM-D... SUB modules for use where a quality universal or VME bus interface is required to solve the problem of interface between electrical and electronic circuits.

The modules connect 9 to 50 position D-subminiature plugs or receptables to screw terminal blocks, for up to 2.5mm^2 conductor cross sections. For ground connection, the metal shell is fixed directly to a terminal block.

The plug casing is secured against undesired loosening and snap easily onto any standard DIN rail.

Modules are supplied completely assembled.

For further information circle 245 on the reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.

Microminiature connectors

Recently released by Utilux is a range of 1.27mm and 0.64mm spacing connectors manufactured by Molex-Ultimate.

Both connector series are of the 'reverse gender' concept, whereby the male pin is the spring member being shrouded in the plug insulator and the female mating tubular socket is unshrouded in the socket insulation.

Due to the close proximity of contacts they are retained in the insulator by epoxy bonding which also seals all existing wires — hence, all connectors supplied are factory terminated.

Solder cup terminals are also available for customers to carry out their own termination and additionally, fully wired units are also available.

For further information circle 247 on the reader service coupon or contact Utilux, 14 Commercial Road, Kingsgrove 2208; phone (02) 50 0155.

Directional power heads

Marconi Instruments has released a new directional power measurement facility for its 2955 series of radio communication test sets.

Two new models have been launched: one aimed specifically at HF communications and a VHF/UHF version covering a range of 25MHz to 1GHz. The directional power heads simultaneously measure forward and reverse power and calculate VSWR automatically.

The units are capable of measuring from 10mW up to 400W PEP and can handle up to 1kW of RF power without damage. This makes them virtually indestructible in the radio communications environment and particularly attractive for military applications.

The units are extremely compact and light, weighing only 0.85kg, making them very suitable for field applications where they fit easily into the front panel cover of the 2955 series.

A real advantage of the new test heads is that the wide frequency coverage and high dynamic power measurement dynamic range is achieved without the need for different power and frequency elements.

For users of conventional bulky through-line wattmeters, this has always been a major inconvenience, especially for field use.

For further information circle 248 on the reader service coupon or contact Marconi Instruments, Level 4, 15 Orion Road, Lane Cove 2066; phone (02) 418 6044.

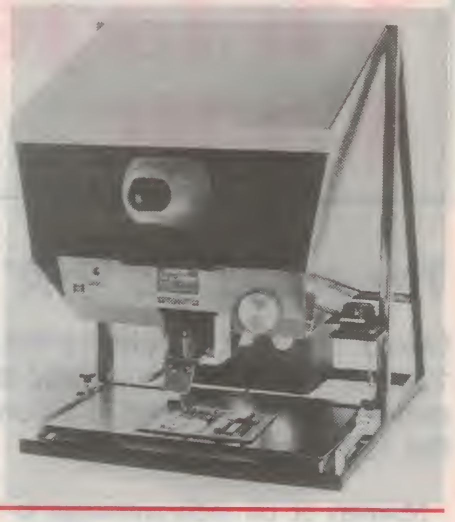
3D PCB scanner

A 3D PCB and surface mount inspection scanner has been developed in the US to meet a military requirement to provide amplified 'apparent' depth to a 3D picture.

This 3D picture accentuates surface quality and simplifies the identification of defects.

The picture is crisp to the edges of the PCB. The standard scanner will handle printed circuit boards up to 20" wide and will resolve one micron at 93x. Objects can be viewed from different angles with extremely high resolution.

For further information circle 243 on the reader service coupon or contact Royston Electronics, 27 Normanby Road, Notting Hill, 3149; phone (03) 543 5122.

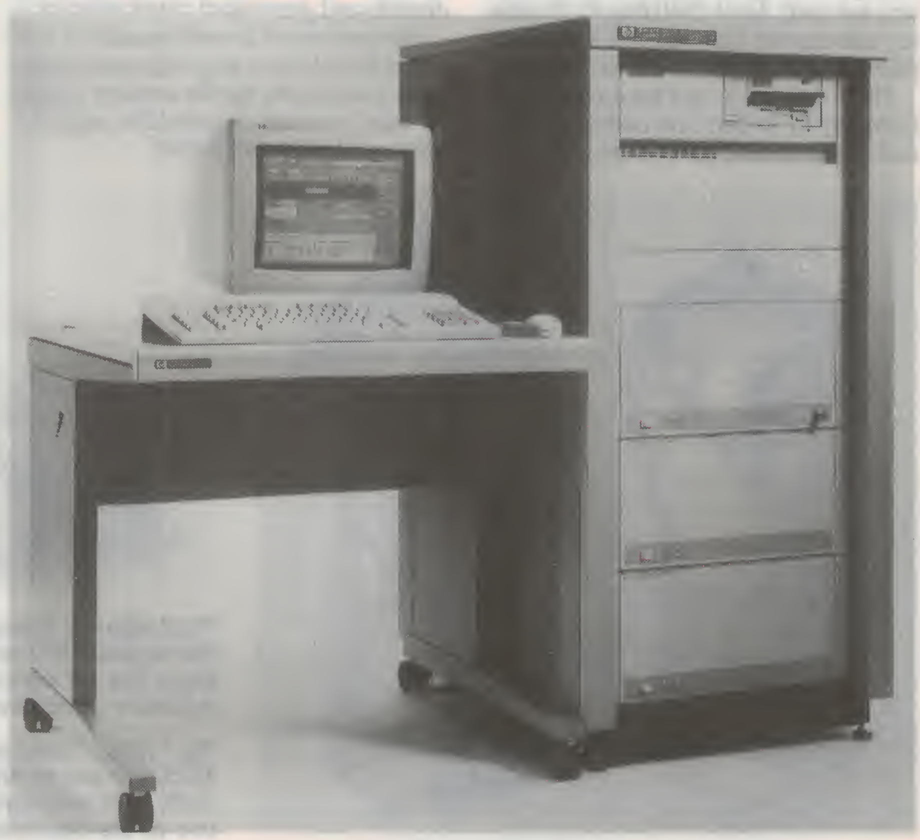


3GHz signal simulator

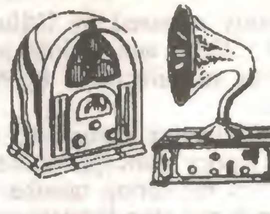
Hewlett Packard has released two more models for its 8791 series of signal simulators. The HP 8791 model 11 is a 3GHz frequency agile signal simulator which features enhance waveform synthesis capability, with four times larger memory than the previous model 10.

This expanded memory and added dynamic sequencing give improvements in signal complexity and in length of sequences needed for simulating the latest multimode radar, electronic warfare and communications signals. The new model also has a power phase-coherent frequency switching mode, which is required for multi-emitter simulation of pulse-Doppler radar and simulation of multitarget returns.

For further information circle 244 on the reader service coupon or contact Hewlett Packard, 31 Joseph Street, Blackburn 3130; phone (008) 033 8212.



Vintage Radio



by PETER LANKSHEAR

The grand old '01A'

One of the most popular valves or 'tubes' ever produced was the UX201A, introduced by RCA in 1922, and its many copies and derivatives. It may well have been the most popular type ever made, and was certainly used in an enormous number of receivers (both commercial and home built) in the 1920's and early 1930's.

Mainstay of US radio production in the 1920's and described in Hugo Gernsback's 1932 *Official Radio Service Manual* as 'the grand old man of radio', the venerable UX201A valve is considered by some authorities to be the most popular type ever made. In 1929, *Radio News* stated that 'more tubes of this design, undoubtedly, have been made than all others combined'.

In production for the best part of 20 years, this remarkable valve was not only the workhorse of the early years of radio, especially in America, but it also remained in production as a replacement during radio's golden era of the 1930's. It was not until April 1940 that *Radiotronics* announced that the '01A was not planned by RCA for further production.

The triode valve had been patented in Germany by Robert Von Lieben in 1906, and nearly a year later in America by Lee de Forest. These were 'soft' (gas filled) valves, as it was thought that some gas was essential to their operation.

De Forest's 'Audion' remained a little understood and erratic curiosity until late in 1912, when the research laboratories of General Electric and Western Electric began independent programs of investigation and development. While Western Electric's chief interest was audio frequency telephone repeaters, General Electric concentrated on radio communication applications. By 1915, both had developed the triode valve to be a well engineered device capable of being manufactured in large quantities with predictable and guaranteed characteristics.

The presence of a small quantity of gas was acknowledged as giving extra sensitivity to detectors, but the need for a high or 'hard' vacuum for amplifier applications was firmly established.

Although there was some equivalence in the designs of the two organisations, there were also significant differences, the most fundamental being the filaments. Western Electric developed rare earth oxide coatings operating at low temperatures, whereas General Electric filaments were pure tungsten operating at white heat. Of later significance was the discovery in 1913 that the tungsten wire containing thoria, used for lamp filaments, gave increased emission at lower temperatures. However, there were problems in its use, and further investigation was shelved.

In 1914, Western Electric introduced a valve base using four contact studs and a bayonet locating pin. This was the UV (U = unit, V = vacuum tube) base, used for many of the early valves.

With America's entry into World War I, both organisations produced large

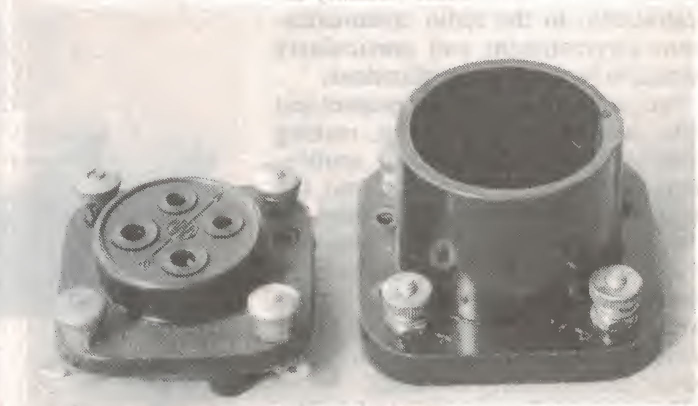


Fig.2 (above): Examples of the types of socket required for the original 'UV' four-pin base, on the right, and the later 'UX' base. The UX socket was made by AWA, and is sprung to minimise microphony.

Fig.1 (left): These two samples of the UV201 were made in 1923, but are externally the same as the original made in 1920. That on the left was made by Westinghouse, while the one on the right was made by GE — RCA's main producer.

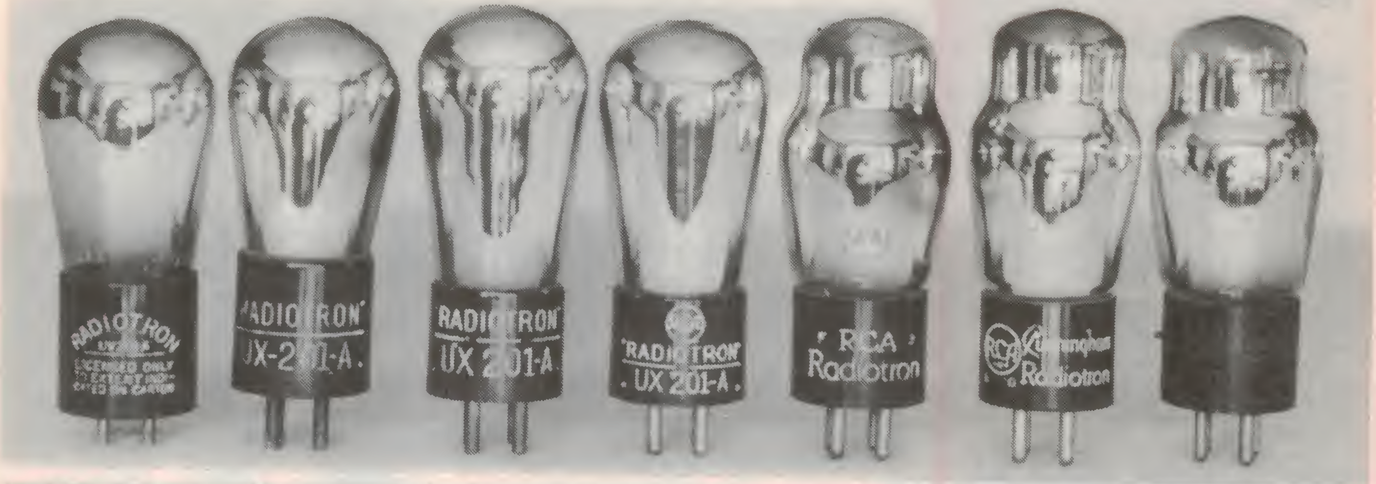


Fig.3: Over a period of a dozen or so years, the RCA 01A was a bit like Grandpa's axe — almost everything changed. From left to right here are shown seven examples with: a composition UV base (early 1925); the original UX base (late 1925); a shorter UX base (1926-7); nickel-plated pins (1928-9); stepped ST bulb and shortened name (1933); combined RCA-Cunningham brand (1934); and the final pattern of 1936.

numbers of valves for military use, General Electric alone producing over 205,000.

At the conclusion of the war, the American Navy became very concerned about the future sovereignty of US overseas radio communications. The future of long distance transmissions at this time depended on Alexanderson alternators built by General Electric, and Marconi was negotiating exclusive rights to these machines, with the potential for a worldwide monopoly.

Following a series of extremely convoluted negotiations, in which they purchased American Marconi and with it, many patent and manufacturing rights, on 19th October 1919 General Electric set up an operating company called the Radio Corporation of America. General Electric were joined progressively by American Telephone and Telegraph, Western Electric, United Fruit Co., Wireless Specialty Co. and Westinghouse.

Not only did this thwart Marconi's monopoly, it neatly bypassed a lot of potential problems with patents. Eventually RCA was itself to be in trouble over monopolies, but that is not part of this story.

RCA announces the UV201

Prior to 1930, RCA was purely an operating and trading organisation, relying on General Electric and Westinghouse for research and equipment. General Electric developed a series of valves for experimenters, amateurs and a potential new market in broadcasting, and in November 1920 a general purpose UV based receiving triode named the UV201 was introduced. A companion UV200 using the same electrodes but containing a small quantity of argon gas was offered for detector use.

At 90 volts HT and a grid bias of 4.5 volts, the UV201 had an amplification factor of 8, a plate resistance of 11,000 ohms and a mutual (trans-) conductance of 0.675mA per volt. Although by later standards this was a very modest performance, the mutual conductance was twice that of the equivalent European 'R' valve and Marconi V24.

General Electric's pure tungsten filament needed far too much current for economical dry battery operation. A more practical source was the freely available American standard 6 volt car battery, which could be discharged to about 5.5 volts. Allowing for 0.5 volt drop in the wiring, the filament voltage of the UV201 was set at 5.0 and this became a US standard. The current at 5.0 volts was 1 ampere.

New filament

Even for car batteries, the drain of a set of UV201 valves was considerable, so the addition of thoria was again researched. Thoria forms an atomically thin layer on the surface of a tungsten filament, but any excessive filament voltage will evaporate this layer, causing a loss of emission. Another problem to be overcome was that of residual oxygen. Pure tungsten will 'clean up' a vacuum, but thoriated tungsten was found to be very susceptible to the slightest trace of gas.

The remedy was plenty of 'gettering', the release of a reactive material such as magnesium inside the envelope after evacuation. This is recognisable as a patch of mirror finish on the envelope, and for the '01A, sufficient was used to cover the whole bulb — a distinctive characteristic of valves with thoriated tungsten filaments.

Although the other specifications remained the same, the new valve required only 0.25 amperes filament current.

The UV201A was released in December 1922, just two years after the UV201. Another significant development from this project was the UV199, a small triode with a 3.3 volt 60mA filament suitable for dry cell operation.

The availability of the economic UV201A was well timed to meet the needs of rapidly growing numbers of broadcasting listeners. In 1922 the number of licenced broadcasting stations in the US had grown to 253 and in 1924 alone, RCA sold nearly six *million* UV201A valves.

More modifications

The original UV base, consisting of a brass sleeve with a ceramic insert carrying the contact pins, was expensive to produce. Late in 1923 a cheaper moulded bakelite base was introduced. At the same time, the exhaust tube was shifted to the base and the mutual conductance raised slightly.

At the end of 1925, a major modification was made to the socket. UV sockets were relatively costly and the stubby valve pins did not always make reliable contact. A new base, the UX, was devel-

Fig.4: Some close relatives, all requiring less 'gettering' than the conventional 01A. From left, Kenrad's model of 1935, with a conventional oxide-coated filament; RCA's own 221, made with a 60mA oxide-coated filament for export only; the Philips A609, with very similar performance to the 01A but only 1/4 the filament current; the 'soft' UX200A detector, containing a small amount of caesium vapour; and an Arcturus 26 (effectively an 01A with a 1.5V/1.05A oxide-coated filament, suitable for AC heating), in that firm's distinctive blue glass bulb.

oped. This had longer pins which could be contacted over a larger area by simple sockets.

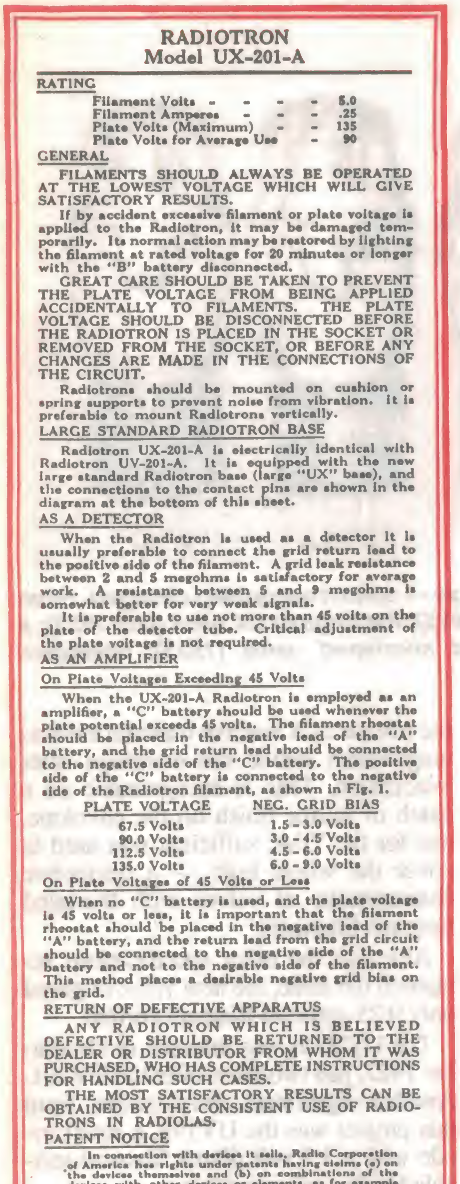
To enable the new valve to be used in existing receivers, the locating pin was retained but repositioned so that the spacing from the bottoms of the pins remained the same. The new UX socket became the standard for small and medium sized American four-pin valves.

A minor problem was that although the UX base would fit either socket, the original UV based valves could only be used in pre- 1926 receivers.

AWA makes the '01A

Overseas, the '01A was in good demand, and in Australia, AWA (note: not AWV) commenced making valves under licence in 1924. Among the types made were AWA101A and AWA101X, UV- and UX-based '01A's.

The popularity of the UX201A inevitably attracted other makers. Between them, RCA's principals controlled all significant valve patents and initially were not prepared to licence other manufacturers. But this was the prohibition era, with 'bootlegging' a popular activity, and it was not long before bootleg '01A's were available.



RADIOTRON
Model UX-201-A

RATING

Filament Volts - - - -	5.0
Filament Amperes - - -	.25
Plate Volts (Maximum) - -	135
Plate Volts for Average Use -	90

GENERAL

FILAMENTS SHOULD ALWAYS BE OPERATED AT THE LOWEST VOLTAGE WHICH WILL GIVE SATISFACTORY RESULTS.

If by accident excessive filament or plate voltage is applied to the Radiotron, it may be damaged temporarily. Its normal action may be restored by lighting the filament at rated voltage for 20 minutes or longer with the "B" battery disconnected.

GREAT CARE SHOULD BE TAKEN TO PREVENT THE PLATE VOLTAGE FROM BEING APPLIED ACCIDENTALLY TO FILAMENTS. THE PLATE VOLTAGE SHOULD BE DISCONNECTED BEFORE THE RADIOTRON IS PLACED IN THE SOCKET OR REMOVED FROM THE SOCKET, OR BEFORE ANY CHANGES ARE MADE IN THE CONNECTIONS OF THE CIRCUIT.

Radiotrons should be mounted on cushion or spring supports to prevent noise from vibration. It is preferable to mount Radiotrons vertically.

LARGE STANDARD RADIOTRON BASE

Radiotron UX-201-A is electrically identical with Radiotron UV-201-A. It is equipped with the new large standard Radiotron base (large "UX" base), and the connections to the contact pins are shown in the diagram at the bottom of this sheet.

AS A DETECTOR

When the Radiotron is used as a detector it is usually preferable to connect the grid return lead to the positive side of the filament. A grid leak resistance between 2 and 5 megohms is satisfactory for average work. A resistance between 5 and 9 megohms is somewhat better for very weak signals.

It is preferable to use not more than 45 volts on the plate of the detector tube. Critical adjustment of the plate voltage is not required.

AS AN AMPLIFIER

On Plate Voltages Exceeding 45 Volts

When the UX-201-A Radiotron is employed as an amplifier, a "C" battery should be used whenever the plate potential exceeds 45 volts. The filament rheostat should be placed in the negative lead of the "A" battery, and the grid return lead should be connected to the negative side of the "C" battery. The positive side of the "C" battery is connected to the negative side of the Radiotron filament, as shown in Fig. 1.

PLATE VOLTAGE	NEG. GRID BIAS
67.5 Volts	1.5 - 3.0 Volts
90.0 Volts	3.0 - 4.5 Volts
112.5 Volts	4.5 - 6.0 Volts
135.0 Volts	6.0 - 9.0 Volts

On Plate Voltages of 45 Volts or Less

When no "C" battery is used, and the plate voltage is 45 volts or less, it is important that the filament rheostat should be placed in the negative lead of the "A" battery, and the return lead from the grid circuit should be connected to the negative side of the "A" battery and not to the negative side of the filament. This method places a desirable negative grid bias on the grid.

RETURN OF DEFECTIVE APPARATUS

ANY RADIOTRON WHICH IS BELIEVED DEFECTIVE SHOULD BE RETURNED TO THE DEALER OR DISTRIBUTOR FROM WHOM IT WAS PURCHASED, WHO HAS COMPLETE INSTRUCTIONS FOR HANDLING SUCH CASES.

THE MOST SATISFACTORY RESULTS CAN BE OBTAINED BY THE CONSISTENT USE OF RADIOTRONS IN RADIOLAS.

PATENT NOTICE

In connection with devices it sells, Radio Corporation of America has rights under patents having claims (a) on the devices themselves and (b) on combinations of the devices with other devices or elements, as for example in various circuits and hook-ups.

The sale of this device carries a license under the patent claims of (a), but only for (1) talking machine uses, (2) radio amateur uses, (3) radio experimental uses and (4) radio broadcast reception; and only where no business features are involved.

The sale does not carry a license under patent claims of (b) except only (1) for legitimate renewals and repairs in apparatus and systems already licensed for use under such patent claims on combinations, (2) for assembling by amateurs and experimenters, and not by others, with other licensed parts or devices, or with parts or devices made by themselves, but only for their own amateur and experimental radio uses where no business features are involved, and not for sale to or for use by others, and (3) for use with licensed talking machines and licensed radio broadcast receiving devices; and only where no business features are involved.

Radio Corporation of America

CAUTION!

DO NOT USE EXCESSIVE FILAMENT OR PLATE VOLTAGE.

HANDLE RADIOTRON CAREFULLY.

Two Stage Audio Amplifier
Fig.1

Detector
Fig.2

Bottom of Base
Fig.3

RC-32814 Rev. 11-25

Fig.5 (left): During the 1920's, information sheets were included with each valve sold. This 1925 revision of the 01A sheet covers the recently introduced UX base. Note the instructions for re-activating damaged filaments.

Small outfits, with frequent factory relocation and brand name changes, kept RCA investigators on the run. But eventually RCA was obliged to grant manufacturing licences.

The number of brand names used is incredible. American valve historian Brother Patrick Dowd has been compiling a register of '01A brand names, and the score to February 1990 was 451!

Many of these valves varied in appearance from the standard RCA pattern. Some were given fancy tubular shapes and coloured glass — generally blue — was popular.

As with the AWA valves, other makers often had variations in their naming. Arcturus, a major user of blue glass called their version 101A, and in Holland, Philips made the C509. Cunningham valves, although supplied by RCA were called CX301A. Increasingly, colloquial and magazine practice was to refer to them all as type '01A.

Offspring

During the mid 1920's, various methods of using mains power were researched. Indirectly heated triodes, such as the McCulloch, with heater connections at the top of the envelope, and with characteristics very close to those of the '01A, were available during 1925.

RCA's first mains-powered general purpose triode, the UX226, first used in 1927 was however, directly heated. It was in fact a UX201A with a heavy 1.5 volt/1.05A oxide coated filament, the

thermal inertia and low voltage minimising hum. An indirectly heated companion detector valve was the stalwart 5-pin based UZ227, again with characteristics very close to those of the '01A.

It was around this period that RCA abandoned tungsten filaments for new designs of receiving and small transmitting valves, but tungsten is still used even today for large valves.

Although the '01A was popular in Australia and New Zealand, car batteries were not always available. Philips obliged with dry cell alternatives, the A409 and A609, requiring only 25% of the filament current.

The popularity of these valves seems to have been noted by RCA, who took the unusual step of producing a valve for export only. This was the equivalent RCA221, with a 5 volt 60mA oxide coated filament. A 125mA filament current version was called UX201B. This current was within the capabilities of gaseous or the then-recently introduced UX280 rectifiers, and the UX201B was intended for receivers using series-connected filaments, supplied by a rectified mains supply.

Final changes

In line with popular usage, and coincident with taking over its own manufacturing, RCA dropped alphabetic prefixes in 1930. The following year the first digit was also discarded, the UX201A finally becoming the 01A.

During 1932, there was one more modification. The familiar constriction was put at the top of the envelope, supporting a mica collar to give improved electrode rigidity. This 'ST' envelope was adopted for practically all receiving valves, which had previously used the traditional 'pear shaped' S bulb. One exception was the 00A, successor to the UV200 — a likely reason being a small demand and a large inventory at the time of changeover.

During its eventful career, the 01A underwent some major modifications, and later practice would have been to give each variation a new type number. Fortunately for the historian, this did not happen.

Although manufacture ceased in 1940, the 01A remained on sale for many more years, and is still available from vintage radio suppliers.

Footnote

Although the 01A was outstandingly successful and popular, RCA rarely used it in their own receivers. They preferred instead the small and economical 199. ■

SHORTWAVE LISTENING

by Arthur Cushen, MBE

Gospel Radio

Gospel radio aims to broadcast in every language by the year 2000. This month, we look at several religious radio stations, frequently heard on shortwave, and also relate the history of three of them, two in the US and one in New Zealand.

The newcomer to shortwave listening will have heard many gospel radio stations broadcasting from all continents. They have an aim under Project 2000 to broadcast in every language of the world by the year 2000. The 'World by 2000' concept is being promoted by three of the major gospel broadcasters, HCJB in Quito, Ecuador, Trans World Radio in Monte Carlo, and the Far East Broadcasting Company, Manila. Many other religious broadcasters, which operate throughout the world, share the aim of the project which is to broadcast in every language.

Shortwave radio is the most effective means of reaching the world's population of 1.5 billion people, and if the idea eventuates, by the end of the century some 260 languages will be heard. The languages broacast this year total 167.

This feature looks at two of the pioneers in the United States. Both are heard 24 hours a day. In San Francisco, KGEI is a familiar voice, and its station was originally built for the World Fair on Treasure Island in San Francisco Bay. Then it was called W6XBE and was a show case station of the General Electric Company which built the 35kW transmitter. Later, power was raised to 50kW and the call changed to KGEI.

In 1941 after the World Fair, the transmitter was moved to Redwood, California, where the station is still located. During World War II the transmitter was used by the United States Office of War Information. In 1943 a further transmitter of 100kW was installed with the call sign KGEX. The transmitters continued carrying Voice of America programmes.

In 1956 the station was returned to the FCC and the 100kW transmitter went to Okinawa for Voice of America programming.

Now it is in Saipan and is used by the Far East Broadcasting company. In 1960 FEBC took over KGEI and has used it for broadcasting to Latin America. It is also used for broadcasts in Russian, with signals being sent over the North Pole to the USSR. The Redwood area in which the station is situated is gradually being covered by housing, and the site of the transmitter and studios is to be moved into one of the valleys of Southern California. KGEI broadcasts to Latin America between 2200-0315 on 15280kHz; 0315-1400 on 9615kHz and 1400-1600 on 15355kHz.

Rhema Network

Unlike Australia, which relies on various stations to carry Christian messages from groups such as the Christian Broadcasting Association, New Zealand has an extensive network of 9 mediumwave and 4 FM stations. These carry programmes of

AROUND THE WORLD

CANADA: The Canadian Broadcasting Corporation has been asked to reduce its budget by $100M, as a contribution to the cost of Canadian Forces in the Middle East. Radio Canada International is being funded by the CBC to March 31. After that, it is expected that it will revert to the External Affairs Department, which will provide the cost of future shortwave listening. When Canada opened on shortwave in 1946, it was paid for by External Affairs, but later it became a charge on the CBC. Now it looks as if the position will again be a case of Government funing. Within Canada there have been major cuts, including one television network which has been closed.

CHINA: Radio Beijing and Radio Moscow have signed an agreement for the interchange of programmes. Five hours each day on Radio Moscow will be a relay of the Beijing broadcast. China broadcasts to Australia in English 0900-1100UTC on 11755, 15440 and 17710kHz; 1200-1300 on 11600 and 15450kHz.

HOLLAND: Radio Nederland is using 15560kHz Monday-Saturday, to broadcast the special English news and features to the South Pacific. The transmission is on the air 0830-0855, and other services are daily 0730-0825 on 9630 and 15560kHz; 1030-1125 on 11890kHz.

MONGOLIA: Radio Ulan Bator has an English service to the South Pacific on Tuesday and Friday: 0910-0940 UTC on 11850 and 12015kHz. Other broadcasts are 1445-1515 on 9795 and 13780kHz, 1940-2010 UTC on 11850 and 12050kHz.

NEW ZEALAND: Radio New Zealand International has been testing on several frequencies, and the present schedule is 1800-2111 Sunday-Friday on 15130kHJz; 2111-0705 daily, except Sunday, 17675kHz; 0705-1110 daily, except Sunday, 9700kHz. On Sunday the broadcast is 000-1110 on 17675kHz. When New Zealand returns to Standard Time on March 17, these broadcasts will be heard one hour later.

PORTUGAL: IBRA Radio, the Swedish gospel group, has broadcasts on the transmitters of Trans Europe at Sines. These have been heard on 11700kHz, with broadcasts in ARabic. The transmission ends at 2100 UTC.

USA: WINB Red Lion PA is using the new frequency of 15295kHz for gospel broadcasts to Europe and the Middle East. Transmissions are on 15295kHz, with German to 2000, then English to sign off at 2100. The station then moves to WINB, Box 88, Red Lion, PA 17356 USA.

YEMEN: The recent amalgamation of North and South Yemen into one country has prompted listening to this area. San'a has been heard on 9779kHz, with news in Arabic at 2100, and sign off at 2110 with the national anthem. There is severe sideband interference from Abu Dhabi on 9780kHz, which also has news in Arabic at 2100 but closes at 2135UTC.

Radio Rhema, a gospel broadcaster with its headquarters in Christchurch.

Radio Rhema was established in 1973, and has spread throughout the country, with stations from Auckland down to Invercargill.

Recently, Radio Rhema commenced 24 hour operation, and many of its mediumwave signals are heard in Australia. It broadcasts on 540, 594, 621, 801, 855, 1251, 1404 and 1503kHz. The station carries a programme for radio listeners each Friday at 1100 UTC on all these frequencies. Radio Rhema is financed by subscription from its members, and is a voluntary radio service. It is expected to expand into the FM bands, once the allocation of frequencies is finalised.

Meanwhile in the South Pacific, the United Christian Broadcasters is establishing a station in Tonga which will operate on mediumwave, shortwave and FM. The next plan is to establish a broadcasting station in Apia, Western Samoa for coverage of that part of the South Pacific.

WYFR Family Radio

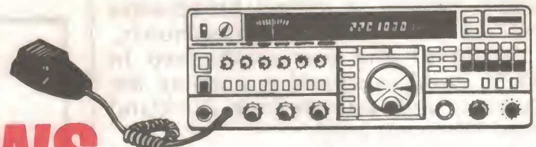
In the 1930s, the familiar private station broadcasting from Boston was W1XAL. It later became WRUL and was operated by the University Club, Boston. The station moved to New York where it was purchased by Family Radio. Now the transmitter complex is in Okeechobee, Florida.

Meantime in Oakland, Family Radio WYFR was formed in 1973, and in the United States it covers 32 stations on AM and FM. WYFR income is received from listeners mainly in the United States and had a budget of $7.5M US last year. The studios in Oakland are linked by satellite down to Florida from which broadcasts originate. These are heard world-wide.

Some years ago, Family Radio signed a document with the Voice of Free China to share air time. Many signals we hear in the South Pacific are not coming from Florida, but from Taiwan. English broadcasts are heard 0500-0600 on 5985kHz; 0600-0700 on 5985, 6065kHz; 0700-0800 on 6065kHz; 1000-1100 on 5950kHz; 1100-1200 on 11830, 13695, 15215and 17845kHz. ■

This column is contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT), which is 10 hours behind Australian Eastern Standard Time.

Amateur Radio News



Big turnout at Gosford Field Day

The attendance at this year's Gosford Field Day was particularly good, and apparently not at all affected by the weather — which turned out to be rather dull, with occasional drizzles. This was no doubt because the Field Day's hosts, the Central Coast Amateur Radio Club, had arranged for all main events and displays to be 'under cover'.

Large numbers of amateurs and their families flocked to the Gosford Showground, with the official parking area becoming virtually 'full' by around 9am and latecomers having to park in surrounding roads.

The traditional sale of 'disposals' gear was very popular, as in previous years. In fact a seemingly endless queue formed at the southern entrance to the Dwyer Pavilion before the opening at 10am, and streamed inside when the doors opened. But the more informal 'flea market' had opened well before that, with many stands doing a brisk trade in the agricultural hall. The very active Gladesville Amateur Radio Club had a display in the same hall, with video monitors demonstrating its ATV transmissions and educational videos.

Talks and seminars took place in the Restaurant from 11am, with an opening talk by Ron Henderson VK1RH on 'WARC 92'. Outside the Dwyer Pavilion were displays showing the development of police radio equipment by the NSW Police, and of amateur satellite TV reception by VideoSat Pty Ltd and 'Julie' Kentwell, VK2XBR.

Under the main covered area behind the grandstand were the many commercial displays and stands, plus those of the WIA NSW Division, WICEN (NSW), ALARA and the Australian Amateur Packet Radio Association.

Firms with impressive displays of amateur radio, components and associated equipment included Stewart Electronic Components, Icom Australia, Dick Smith Electronics, Emtronics, Kenwood Electronics Australia, Andrews Communications, Captain Communications, Oatley Electronics and RCS Radio.

Another very interesting display in the same area was 'Television Equipment of Yesteryear', presented by Vic Barker VK2BTV. This included an original British 405-line receiver, playing a fascinating and historic 405-line recording of an early telecast by the BBC in this now long-defunct system.

All in all, the 1991 Field Day was a most successful event, and one which demonstrated that amateur radio is still thriving in VK2. The Central Coast Amateur Radio Club, and its Field Day Committee in particular, are again to be congratulated for organising such a well-planned and smoothly run function. (J.R.) ■

Part of the long queue of people waiting to go into the Dwyer Pavillion for the disposals sale. The queue was much longer than this!

EA with ETI marketplace

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Information centre

Conducted by Peter Phillips

Seeking the perfect component

The mystical 'perfect' component gets an airing this month following reader letters on recent What?? questions. But reality also creeps in, with letters asking the usual range of diverse questions.

When you enter the world of electrical theory, it helps considerably if you can leave reality behind as this abstract force is mostly invisible. Plumbers have water in pipes, hydraulics engineers can see the oil pushing the cylinder, gas fitters can (if nothing else) smell or sometimes even see the gas. But electricians and electronics folk have to rely on mathematical equations.

It gets worse when electrical theory moves into describing transformers, capacitors and other real world components. Because nothing is perfect in reality, it is usual to talk about the 'ideal' component and to ignore parameters that can make practice and theory disagree. The sweeping statement 'ignoring losses' is a way of getting around numerous problems that are otherwise rather difficult to explain — although it doesn't always work that way, as this month's first correspondent points out...

Losses don't matter

I don't know if you were trying to be deliberately provocative (or just careless) with your wording of the capacitor voltage problem you posed in the What?? question of January 1991, but your final injunction to 'assume no losses in the circuit' is unnecessary, unrealistic and physically impossible.

It is unnecessary because, if the problem is tackled by examining what happens to the capacitor voltages as charge flows around the closed circuit, a solution is obtainable without any assumption about loss.

If one examines the energy stored in the capacitors, before and after switch closure, it will be found that the original 133.3mJ decays to 33.6mJ. The difference doesn't just disappear; it is dissipated in circuit resistance. The value of this resistance is unimportant, as it merely determines the period required for the voltage distribution.

But this resistance cannot be abolished at the stroke of a pen. For instance, even if the resistance was reduced to say, one millionth of an ohm, the foregoing results would still be achieved, assuming the mega-mega-ampere (peak) current didn't have an untoward result!

This can be seen by analysing the circuit operation with resistance included, but given a specified value. The solution requires the use of integral calculus (which perhaps you were trying to avoid), but is notable that the final voltages are independent of the resistance value as it simply disappears from the equation.

Apart from this quibble, the question (like most of them) is entertaining and educational. Keep up the good work, but remember — people are watching. (G.W., Florey ACT).

I totally agree G.W., except what I meant was to ignore leakage resistance of the capacitors. Certainly any series resistance is unimportant, and this question is sometimes posed showing a series resistor in the circuit. I should perhaps have been more explicit.

But capacitors aren't the only imperfect component. Transformers and the theory behind their operation is another topic where the 'ignore losses' statement is often used. The next letter takes me to task on a reply I gave about transformer VA ratings in December 1990:

Transformer ratings

I refer to the 'Transformer ratings' article in December's Information Centre. Your reply seems either misleading or misinformed for the following reason:

The flux density in a given transformer core is largely independent of the current being drawn from the secondary. The core is magnetised by current flowing through the magnetising reactance, which can be thought of as an inductor in parallel with the primary of the ideal transformer. For a given transformer, that current (and therefore the flux density in the core) is dependent on the frequency and applied voltage.

If the magnetising reactance is too small (insufficient primary turns), the core will saturate with no load at all on its secondary. In other words, the core cannot be made to saturate by loading the secondary. If anything, the higher load current will tend to reduce the flux density by increasing the voltage drop across the source resistance feeding the primary (S.D., Dulwich SA).

Yes, I agree S.D. — providing the secondary current is a sinewave. But the discussion concerned a rectifier circuit with a large filter capacitor where the secondary current is in the form of short, sharp bursts of current — giving rise to a possible DC component. The effects are really twofold, in which excessive load causes the flux in the core to drop, (cancellation of the primary flux by the secondary flux) and a possible shift in the operating point on the magnetisation curve.

In the first case, the size of the core is not a problem, as the flux has ac-

tually dropped due to the inability of the primary winding to conduct sufficient current to counteract the effect of the current in the secondary. This is due to the resistance of the primary winding rather than core size.

But if the operating point of the magnetisation curve (BH curve) is changed, saturation can occur. This will occur particularly for a half wave rectifier, and because most transformers operate near the top of the magnetisation curve, it doesn't take a great deal to push the core into saturation. In this instance, a larger core will be able to accommodate a shift in the operating point better than a smaller core, as the percentage change will be less.

Whether this effect is a problem for a full wave rectifier is not quite so clear, as the next letter may show...

DC in the primary

I've been waiting for letters on the January What?? question, and sure enough I've not been disappointed. The correspondents disagree with the answer, in which we stated that a transformer with a half wave rectifier as the secondary load (no capacitor) will have NO DC component in the primary. I'll print one letter only, as the writers all say much the same thing by suggesting that a sensitive DC ammeter will in fact register a DC component in the primary:

Concerning the January What?? question, surely your answer is incomplete. If as you say (correctly) the positive half cycles of the primary current waveform are different from the negative half cycles, then the average value of each positive half cycle must be different practically all the time compared to the negative half cycles.

If a DC ammeter (moving coil type) is sufficiently sensitive, it will show this difference. The practical problem is that in most cases a DC ammeter that is sensitive enough would be destroyed by the RMS (heating value) of the full cycle.

So the primary current must comprise a small DC component, which should not be confused with the initial flick of the meter at turn on. (I.M., Christchurch NZ).

I'm going to stick with my original support for the answer supplied by the Mr Soong, who posed the question in the first place. I said before that I hooked up a test circuit and confirmed the answer, using a digital multimeter as the ammeter (Fluke 77).

When the letters started arriving, I repeated the experiment using a moving coil ammeter and also a CRO connected to monitor the primary current. The ammeter gave interesting results, which actually suggest that the correspondents are correct. I found that a DC component was present with no load on the secondary (!!), and that this component increased in the positive direction for one polarity of the diode and increased in the opposite direction for the other polarity.

To monitor the primary current with a CRO, I supplied the transformer under test via an isolating transformer (240:240) and connected the CRO across a resistor placed in series with the second primary. Predictably, the waveform showed a different shape for one half of the cycle compared to the other half. But the *area* enclosed by each half cycle above and below the zero line remained constant, (as far as I could determine).

It may be that a small transformer will cause a slight DC component in the primary current due to all kinds of effects (the non-ideal transformer), and that this will be registered by an equally imperfect moving coil ammeter. But given 'perfect' components, I argue there will be no DC component. What do other readers think?

Leaving theory to rest for a bit, the next letter offers comments on the answering machine tester mini project described in May 1990.

Project problems

I recently built the answering machine tester (May 1990) and needed to solve a few problems to get this project going. They mainly concerned IC1, a 555 timer connected as an astable. I found it did not work at all, which was solved by connecting the 100k trimpot to the supply rail (pin 8 of IC1). I also changed the 150k resistor to 100k for better timing results. The waveform at pin 3 of IC1 should be 146ms high and 94ms low assuming a standard cradle-mount relay with a coil resistance of 200 ohm, 12V to 24V. However, other relay types might cause timing problems.

The parts list does not include the 0.01uF capacitor connected to pin 5 of IC2, and the 1000uF capacitor connected to D1 is incorrectly listed as 100uF. I also suggest that a 6.8k resistor be connected across the 5000uF filter capacitor, to avoid being zapped while working on the circuit. I also added a power-on switch and a line fuse for added safety.

To set the 100k trimmer associated with IC1, connect a 'scope to pin 6 of the phone socket and adjust the trimmer until the required pattern is achieved. The two second off-time can be readily seen and the 500k trimmer (on IC3) can also by adjusted quite easily. The end result is according to Telecom specifications.

Thanks for a worthwhile project and keep up t he good work. (B.C., McKinnon Vic).

And thanks to you, B.C., for sharing your findings with us and other readers. Our next letter seeks advice on the Master Control power switch described in January 1990.

Master switch

I recently constructed the Master-Slave switch (Jan. 1990). It worked immediately and perfectly on bench testing. However, when installed to control my hifi system, I find it is sensitive to other appliances on the same power circuit (washing machine and so on). When the other appliances turn on, the relay in the project snaps rapidly on and off, disrupting tape recording and programming of my CD unit.

As it would involve extensive and expensive rewiring to put the hifi on a separate breaker, I seek advice on how to modify the unit to make it immune to interference. It seems the built-in line filtering is not up to the task. (E.G., East St Kilda Vic).

I think the problem may be insufficient load for the switch. The project works on the principle that the current taken by the 'master' appliance causes a relay to operate, which in turn switches other appliances. I have one of these units connected to a VCR with the relay switching a TV set, and have had absolutely no problems for the 12 months I've has this setup. But I know that if the master appliance draws too little current, unreliable operation can occur.

Although you don't give details, E.G., I presume the amplifier of your hifi setup is being used as the master appliance. If so, I would think an amplifier on its own would be on the border line for an adequate load current. The simplest solution would be to connect another load in parallel with the amplifier (a lamp or similar). This load would have to be activated by the power switch of the amplifier, possibly via a power outlet already fitted to the rear of the amplifier.

Audio ICs

The next letter asks two totally unrelated questions:

I am writing to enquire about the TDA range of audio power amplifier ICs. These come in 5-pin TO-220 packages and I'm interested in them as they are relatively cheap, require less external components than other ICs and give a good quality output.

I was hoping you might have information on these devices or perhaps you are planning a project that uses one. If not, could you direct me (and other readers) to a source of data for these ICs. I need pin connections, their specifications and typical applications.

By the way, why is it 'an' LED? I may be ignorant, but to my knowledge 'an' is only used before a word beginning with a vowel, or a word beginning with one or two consonants sounding like a vowel. Is it just another anomaly of the English language, or did some bigwig in the deep dark past decide to be different for a change?

Keep up the good work. EA's a great mag. (K.B., Wellingrove NSW).

The TDA devices have been around for many years, and can be found in Philips data books to name but one. Although it doesn't include actual data, the Farnell catalog lists quite a range of TDA type devices. Farnell also provides data sheets for most of the ICs it sells, so I suggest you give this firm a ring on (02) 645 8888 or write to 72 Ferndell Street, Chester Hill, NSW 2162.

As for whether we should say 'an LED' or 'a LED', this is a sticky one. Some people in electronics still see the term as an acronym for 'light emitting diode', pronouncing it as 'el-ee-dee' and hence writing it as 'an L.E.D.' (because 'el' starts with a vowel). On the other hand common usage nowadays is to give the acronym the status of a word in its own right, pronouncing it as simply 'led' to rhyme with 'bed', and as a result writing it as 'a LED'.

If the device had been called a 'diode, light emitting', no conflict would have arisen as 'a' fits both this, the acronym 'D.L.E.' and the contraction 'DLE'. But 'led' sounds a lot better than 'dleee', so there's no real answer.

Digital TV

Following my admission in December 1990 that I didn't really know how a digital TV works, a colleague (M.J., Sydney) took the trouble to supply me with literature and a circuit diagram of a digital TV set. It all seems so simple now, and in case other readers aren't sure, here's a potted version of their operation.

It all starts with a digitally controlled tuner, in which station selection is achieved by applying a DC voltage to a varicap type tuner. The DC voltage is developed by a process that involves frequency synthesis, in which a sample frequency from the tuner is compared to a programmable reference. The advantages include memory store facility for up to 99 TV stations, automatic fine tuning, ability to scan through the spectrum and so on.

The output of the tuner is then amplified in the usual way by an IF stage, giving a conventional composite video signal (analog) at the output of the IF stage. But from here on in, digital technology takes over. The composite video is applied to an IC often referred to as a CODEC (code-decode) in which the analog signal is converted to a 7-bit digital signal. Within the CODEC, other sections look after the Teletex option, (usually with an 8 page RAM) as well as the sync signals and the actual video signal.

From the video section, a 4-bit chroma signal is produced along with an 8-bit luminance signal. Subsequent conversion back to analog gives the usual RGB signals.

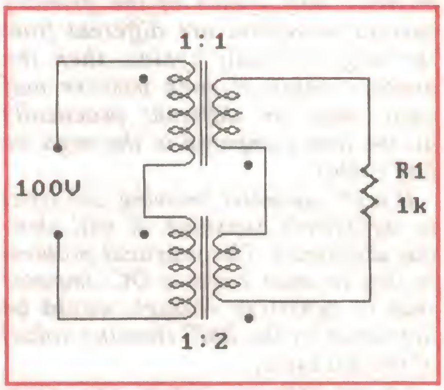
The main advantage is that an extremely steady display will result under severe noise conditions, giving a subjective improvement in the picture quality. Another unusual feature is that the various 'settings' such as height, width, linearity, grey scale and so on can be stored in an EEPROM, eliminating the usual preset potentiometers. By reprogramming the EEPROM, these settings can be adjusted.

Seems complex, but the end result is an improved picture and a TV set with mind-boggling features and very few controls. In fact they look so good I'd buy one, if they didn't cost an arm and a leg!

What??

I'll bet this question (or more correctly, the answer) creates some heated discussion. I'll sit back on this one, as although I agree with the mathematics that explain the answer (next month), it all seems rather odd somehow. The question is posed by Gordon Wormald from Canberra, and concerns ideal transformers. The question is:

Two ideal transformers with ratios of 1:1 and 1:2 are connected as shown

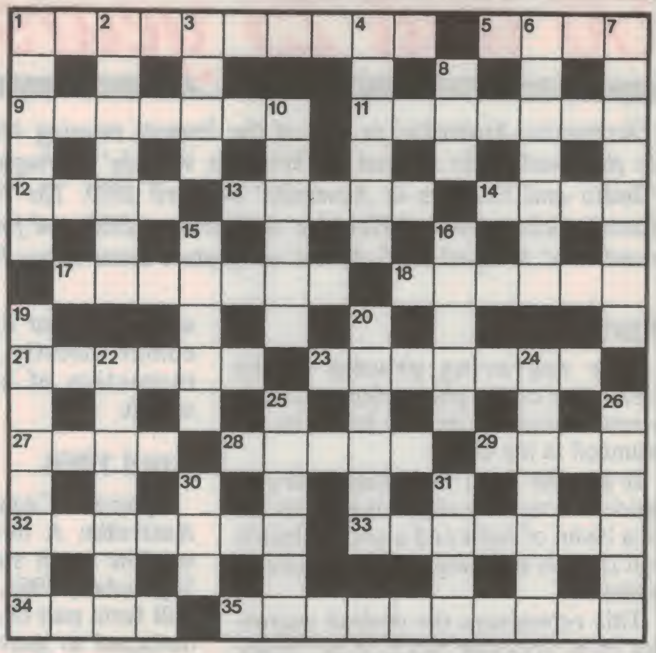


in Fig.1, with a load of 1k applied across the series-connected secondary windings, phased as shown. Determine the current that flows in the resistor. Remember, these are IDEAL transformers...

Answer to last month's What??

What's inside the black box — a 6V light globe!!!

EA CROSSWORD



Across

1. Increase signal strength. (10)
5. Temporarily suspend communication circuit. (4).
9. Again sends initial message. (7)
11. Robert H. Goddard is famous for developing these. (7)
12. Hobbyists may have these radio-controlled. (4)
13. Nobel prize winner Paul ------, noted for electron theory. (5)
14. Electric/magnetic interaction, the ---- effect. (4)
17. Lightning hits. (7)
18. Laptop grip. (6)
21. Device used with microfilmed data. (6)
23. Significant moment at a launch pad. (4-3)
27. Significant authority at a launch pad. (4)
28. Nature of dry cell's chemicals. (5)
29. Effect at an electrified point. (4)
32. Pertaining to electrical induction. (7)
33. Said of certain equilateral shapes. (7)
34. Units of radiation. (4)
35. Producer of AC. (10)

Down

1. Degree of non-contamination. (6)
2. Change to code. (7)
3. Type of connector. (4)
4. Orderly arrangement. (6)
6. That which is multiplied, divided, etc. (7)
7. Remove metallic binder. (8)
8. Form of data display. (1,1,1).
10. Sudden surges. (6)
15. Unit in a graphic display. (5)
16. Sense. (5)
19. Convey data display else where. (8)
20. Movement of unstable image. (8)
22. Major brand of computer. (7)
24. This could be said of a word. (4-3)
25. Computer language. (6)
26. To EA readers, a well- known electronics retailer. (6)
30. Method of obtaining a posiitional bearing. (1,1,1)
31. Protection in high-voltage situations, the ---- gap. (4)

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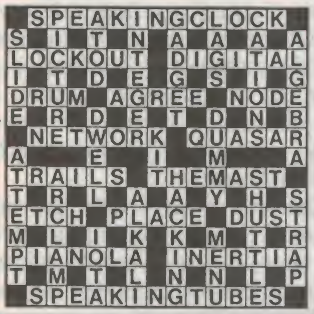

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APR '91

50 and 25 years ago..

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

April 1941

New engraving process in the USA: Use of the photo-electric cell in a new engraving process has been announced in the USA.

It departs from the usual acid-etch process in making engravings in its use of a beam of light and a photo-electric cell to scan a photographic negative or positive.

This reproduces the desired engraving on a type-high block of stereotype metal. Impulses received as the beam of light passes over the copy cause an electrically controlled cutting device to engrave the image on the plate.

Stereophonic sound: In ordinary talking motion pictures, no matter where a character stands in the scene, his voice comes from a behind-the-screen horn which is in a fixed position. A far more natural effect is secured when the voice apparently comes directly from the actor, irrespective of his position on the screen.

April 1966

Space Communications in Australia: A new communications satellite earth station to be built by September, 1966, at Carnarvon, WA, will form part of a world-wide system designed to provide communications between tracking and control stations engaged in the NASA Apollo (manned landing on the moon) project, through satellites located over the Atlantic and Pacific Oceans.

The new stations will be operated by Overseas Telecommunications Commission (Australia).

The Carnarvon station will be one of a chain, other stations being located at Canary Islands, Ascension Island, Andover, Maine (USA), Brewster Flat, Washington (USA), Paumalu (Hawaii) and on NASA owned ships in the Indian, Pacific and Atlantic Oceans.

Received signals, which are extremely weak, are passed to a special radio receiver designed to minimise its inherent noise level.

This receiver operates in an atmosphere of helium refrigerated to a temperature in the vicinity of 420 degrees below zero on the Fahrenheit scale.

Electronic telephone exchange: To meet the demands of modern telecommunications users, Associated Electrical Industries of London has developed an electronic telephone exchange, as a joint project with British suppliers of telecommunications equipment and the British Post Office.

The new electronic exchange, known as REX (Reed Electronic Exchange) employs electronically operated reed relays for the switching functions. It has been developed to provide compatibility with existing automatic telephone exchanges.

The electronic control uses the advanced stored program technique. It is simple in operation, with self-checking and reporting facilities for maintenance purposes. ■

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RAMTRON'S NEW FMx 1208 4096-BIT NONVOLATILE DRAM CHIP: FIRST OF A NEW BREED OF MEMORIES

RAMTRON RELEASES FIRST 'NONVOLATILE DRAM'

Australian high-tech developer Ramtron Holdings has announced that its majority-owned US subsidiary Ramtron International has begun shipping evaluation samples of the FMx 1208, a 4096-bit nonvolatile DRAM device which combines the company's FRAM (ferroelectric RAM) technology with conventional CMOS DRAM memory technology. The devices are apparently being manufactured by Ramtron at its own Class 1 sub-micron 6" wafer fabrication facility in Colorado Springs, and also by licensee Seiko Epson at its facility in Fujimi, Japan.

The new device is Ramtron's first FRAM-DRAM device to be released, and uses an integrated two-transistor/two capacitor (2T/2C) storage cell fabricated using 3.0um design rules. Each storage cell measures just over 1400 square microns, little more than 1/10th the area of the 11,310um^2 8T/2C cells used in the firm's first static FRAM device of 1988.

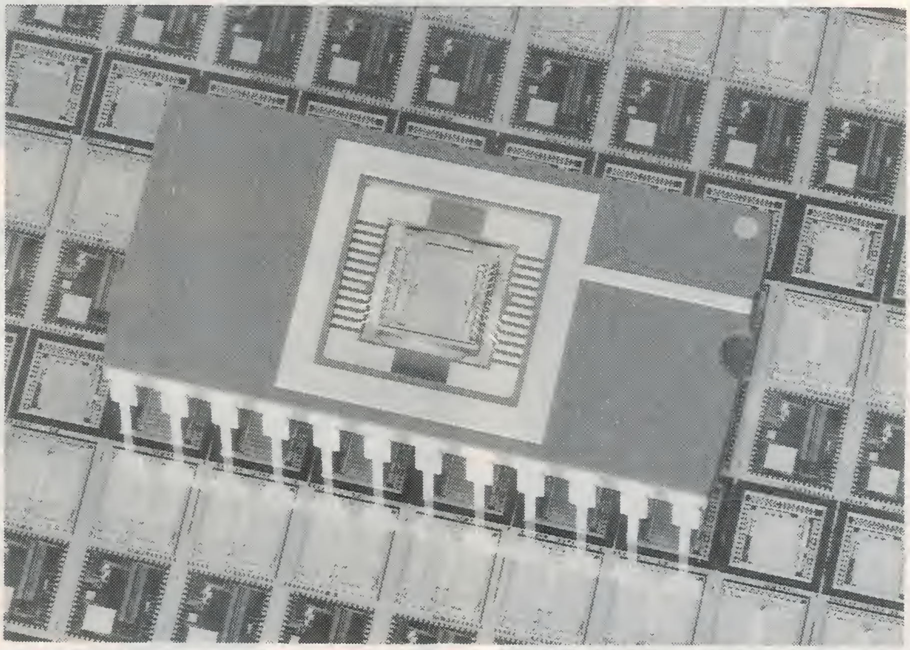
The FMx 1208 is organised as 512 x 8-bit words, and offers 500ns (maximum) symmetrical read/write cycles (250ns read access) in its dynamic DRAM mode. In this mode it operates very much as a normal non-multiplexed DRAM memory.

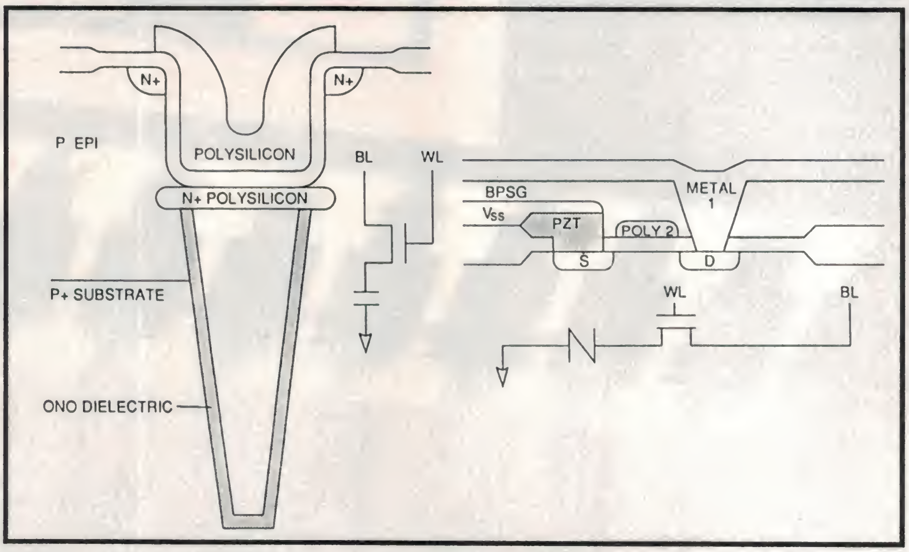
However a mode control pin allows it to be switched to 'nonvolatile' mode just prior to loss of power. In this mode the charge in the cell storage capacitors can be 'written' into the PZT (lead zirconate-titanate) dielectric as bistable ferroelectric polarisation. (For an explanation of the principles of FRAM operation, see *Electronics Australia* June 1989, page 32: 'A Revolution Looming in Computer Memories'.)

Writing of the cell data into the PZT elements before power-down requires a sequence of 4096 refresh cycles (64 per row), to ensure reliable nonvolatile storage of up to 1 year without power.

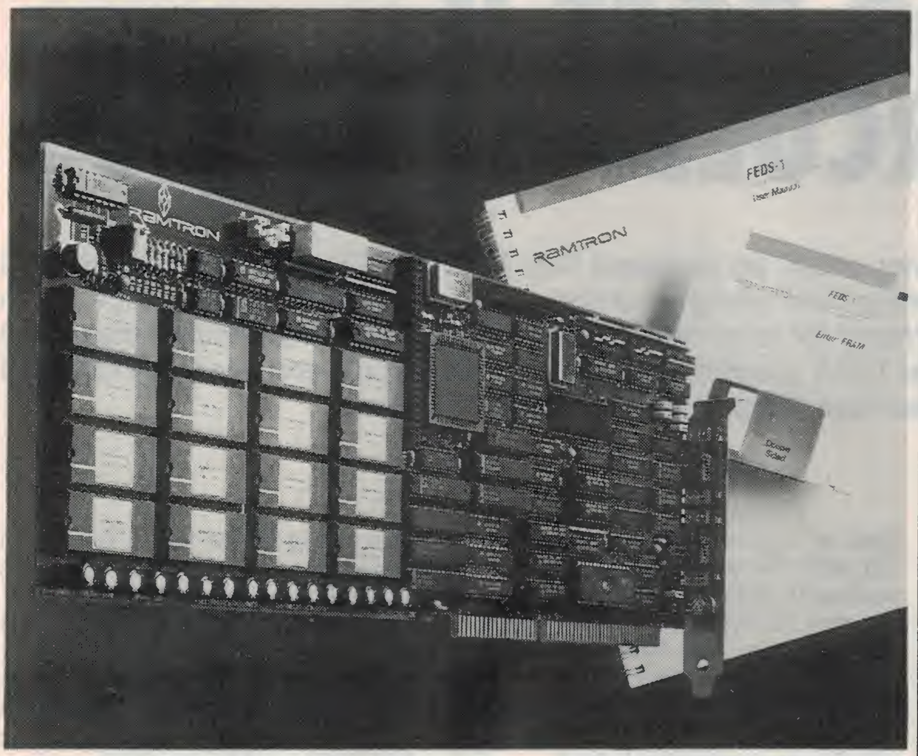
Upon power-up a further sequence of 64 refresh cycles (one per row) is required to convert the data from dielectric polarisation back into charge.

The FMx 1208 is then switched into normal DRAM mode, and refreshed every 1ms in the usual way. This dual mode of operation effectively circumvents the acknowledged tendency of PZT material to exhibit 'fatigue' — a gradual degradation of its ability to





A comparison between the construction of a conventional 'trench' type 1T/1C DRAM memory cell (left) and one of Ramtron's planar 1T/1C cells using PZT as the capacitor dielectric. The much higher dielectric constant of PZT gives virtually the same capacitance — as well as the ability to provide nonvolatile storage.



Along with the FMx 1208 chip, Ramtron has released this FRAM evaluation and development subsystem called FEDS-1. As you can see its a card which plugs into AT or compatible computers, together with matching software.

change and retain polarisation, with continued polarisation reversals.

In normal DRAM mode the polarisation of FMx 1208 cells is not changed, only the charges, so that polarisation changes only occur during a power-down write cycle — not during normal data storage/retrieval cycles. The FMx 1208 is rated to provide reliable data retrieval for at least 10^6 power cycles, corresponding to a very long life in most conceivable applications.

Although the 4Kb storage capacity of the FMx 1208 is very modest by current standards, Ramtron expects applications to include telephones, video cameras, postage and power meters, and electronic identification devices.

The company has also released an FRAM evaluation and development subsystem called FEDS-1, in the form of a card which plugs into AT or compatible computers. Based on an Intel 8097B 16-bit microcontroller running at 12MHz, the card has a control program stored in 16 of the FMx 1208 devices. It is available to qualified customers at a price of US$4995.

Along with the FMx 1208 device, Ramtron is also releasing 1Kb and 2Kb versions. A 16Kb device is also expected before the middle of the year.

FRAM devices with much larger storage capacities are also well advanced in development, according to Ramtron's Deputy Chairman Ross Lyndon-James. Apparently a 256Kb nonvolatile DRAM using 1T/1C cells and 1.2um geometry is expected to be released in developmental sample form before mid-year.

A 4Mb nonvolatile DRAM using 0.8um geometry and 1T/1C cells is also under development at Seiko Epson, and is predicted to become available in early 1992.

Unlike standard DRAM devices of the same capacity this uses 'trenchless' capacitor construction, taking advantage of the fact that PZT material has a dielectric constant some 200 times greater than the silicon oxide and nitride normally used.

For a given chip cell area, PZT thus allows a simple planar capacitor to achieve the same charge storage capacity as a trench capacitor, so that device fabrication can be dramatically simplified.

Of course the fact that PZT also offers nonvolatile storage is a further bonus, which Ramtron is confident will give it the key to an as-yet untapped market estimated to be worth up to US$22 billion worldwide in 1992. (J.R.) ■

LISTENING POST II GETS HERCULES GRAPHICS

Back in the January issue, you may recall, we reviewed Tom Moffat's kit for the new improved PC version of his very popular 'Listening Post' design — a low cost hardware/software package which converts the computer into a terminal for receiving radiofax, RTTY and Morse. At that stage, the new design only provided modest 'CGA' graphics resolution for fax display and printout; but now it is available with much higher resolution 'Hercules' (HGA/MGA) graphics...

by JIM ROWE

When I reviewed the new Listening Post II kit and design for the January issue, I found it very impressive. It certainly lived up to its claim to provide a low cost, easy to drive method of using an existing PC to explore the fascinating world of weather fax, RTTY and Morse code transmissions. And once its designer Tom Moffat had solved a few little 'bugs', it also turned out to be highly compatible with a wide variety of IBM PC-family machines.

Probably my only remaining reservation about the design was that it provided only modest 'CGA' type graphics display and printout, for the received and decoded fax images. This was regardless of whether the computer was fitted with a CGA video card, or one of the higher resolution EGA, VGA or Super-VGA cards. It wouldn't work at all with a higher resolution 'Hercules' type monochrome graphics (HGA/MGA) card, either.

I had discussed these limitations with Tom, and he'd agreed that Hercules and high resolution versions would be desirable. However with his very limited resources, he had been forced to defer development of these versions until he could gauge the likely demand.

Near the end of the review, I predicted that Tom would probably be inundated with people wanting either Hercules or EGA/VGA/Super-VGA versions. And I gather that this prediction turned out to be right — so much so that Tom apparently decided to invest in both Hercules and Super-VGA cards, and get cracking with the higher-res versions.

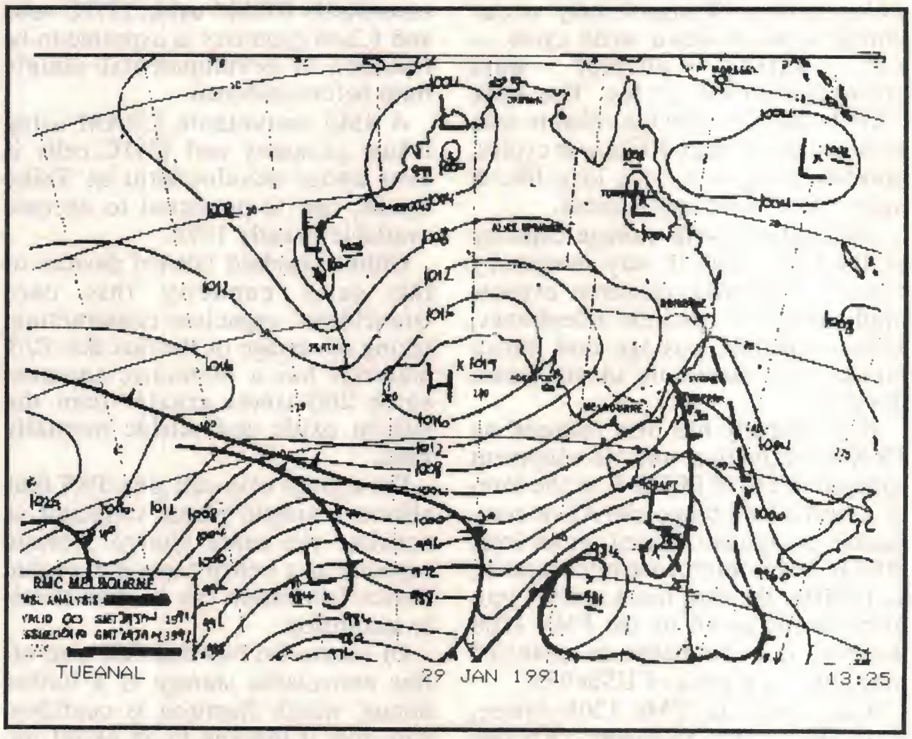
At this stage he has fully completed and debugged the Hercules version, which has now become available — both as a complete kit, and as an 'upgrade' for any kits that have been purchased already. And I gather that versions for EGA and higher resolution cards are well and truly 'in the pipeline'. In fact he sent me a sample of an 800 x 600 pixel printout from his experimental Super-VGA version, and it looks *very* impressive indeed.

The Herc version

Tom very kindly sent up one of the first upgrade kits for the new Hercules/MGA version, so that I could try it out. The upgrade consists essentially of a small 'bag of bits', plus a new software disk and an instruction sheet.

The reason for the bag of bits is that the new version needs the decoder's crystal clock to run at a different frequency, to correspond to the different scanning rates and 'dot clock' used by the Hercules graphics card. In fact the crystal oscillator now needs to run at 5.898240MHz, rather than the 4.9152MHz used for the CGA version.

The conversion parts consist of a new 5.900MHz crystal, a 47pF ceramic cap to replace the original 33pF unit for C9, and a 22uH inductor to fit in series with the new crystal so that it can be 'pulled' to exactly 5.898240MHz using existing trimmer C11.



A sample fax print out from the new Hercules/HGA version of Listening Post II, printed out on an Itoh dot matrix printer. As with the screen display, the resolution is considerably better than with the original CGA version.

The new software disk supplied with the upgrade provides rewritten 'Hercules' versions of the FAX, SHOW and PRINTFAX programs for decoding, displaying and printing the received fax signals. Or strictly, it provides the new 'master' versions of these programs, which are converted into your working copies during installation.

How it went

Carrying out the hardware side of the upgrade was very easy, using Tom's instruction sheet. There was no trouble in setting the modified crystal clock to the new frequency, either, with just a few tweaks of the trimmer. Then it was simply a matter of installing the new versions of the software, and trying it out.

Thoughtfully Tom had provided samples of some good weather fax images saved on disk in the new Hercules format (which is different from, and incompatible with, the original format), so it was a simple matter to look at the new improved display resolution. And was it better!

There really is a very significant improvement, thanks to the higher resolution of the Hercules card — 720 x 348 pixels, compared with the CGA's 640 x 200 pixel resolution in mono graphics mode.

Happily Tom has also been able to achieve the same order of improvement in resolution with the printed images. These are not only clearer but also larger, having increased in size by virtually the same factors as the resolution increase. On my 'DSE DataMate' Epson-clone dot matrix printer the new images were 140 x 105mm, compared with the 120 x 60mm size produced by the original version. I notice that a sample printout from Tom's own Itoh machine now measures an even more impressive 178 x 120mm.

Needless to say, I also tried searching around on the HF bands, to see if I could find a weatherfax signal to test the modified decoder. After quite a bit of searching (it was daytime), I finally found one, from AXI in Darwin. And it decoded very nicely, after only a few minor adjustments to the 'Clarifier' knob on the receiver to set the FSK tones. I got a nice picture of the highs and lows around Australia — although not as clean as Tom's sample of a similar chart from Melbourne.

In short, then, the Hercules version of Listening Post II gives really excellent results, judging from my experience with the upgrade. Owners of machines with Hercules/MGA graphics cards should be more than happy, I'd say.

Unfortunately the new version of the Listening Post II costs a little more than the original, because of the rather more expensive crystal it uses. Tom advises that he has to sell it for $69.00, plus $7.00 as before for packing and postage anywhere in Australia and New Zealand. But this is surely still a very reasonable price, considering what it does and the effort he has had to put into the software alone.

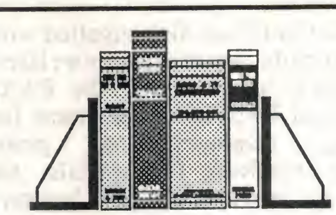
For those that have already purchased the original kit and would like to upgrade to the Herc version to get its higher resolution, this is available for $33.00 plus $7.00 P&P.

Of course you'll need to have a Hercules/MGA graphics card to take advantage of either the new version or the upgrade.

Incidentally the original CGA version is still available, for those with these video cards, at the original price of $59.00 plus $7.00 P&P.

As noted in the earlier review, the Listening Post II is only available by mail order from High Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7054. ■

NEW BOOKS



Laserjet companion

LASERJET UNLIMITED, by Ted Nace and Michael Gardner. Second edition, published by Peachpit Press, 1988. Soft covers, 180 x 228mm, 512 pages. ISBN 0-938151-02-9. Recommended retail price $49.95.

Over the last few years laser printers have become very popular in offices, because of their high quality output and low noise level. And Hewlett-Packard's original *Laserjet*, in one of its versions, is probably still the most popular model in corporate applications, despite the appearance of many functional clones and derivatives.

In the USA, this book has apparently become one of the most widely accepted reference books on using the Laserjet and getting the most from it, when you're using a wide variety of software. It was apparently written with the active assistance of H-P's Laserjet division, and Bill McGlynn the marketing manager of the division has even written its Foreword. He's quoted as saying that:

Hewlett-Packard has worked with the authors to ensure technical accuracy and the make sure Laserjet Unlimited is one of the best Laserjet printer tools available. This book is a first-rate reference for dealers, users and trainers alike.

Browsing through it certainly seems to confirm this. It seems to cover just about every conceivable aspects of both the Laserjet's operation and its optimisation for use with the various kinds of software, at both an 'elementary' and 'advanced' level, and with a lot of technical programming detail.

There are some 28 chapters in all, divided into nine sections titled 1 - Basics; 2 - Word Processing; 3 - Graphics; 4 - Desktop Publishing; 5 - Spreadsheets, Databases and Forms; 6 - Fonts; 7 - Special Topics; 8 - Enhancements and Upgrades; and 9 - Appendices.

All in all, it seems an excellent reference for anyone who needs to use and/or program an H-P Laserjet. It may also be of considerable value to people with one of the many 'clone' lasers which provide a Laserjet II emulation.

The review copy came from Peachpit Press's Australian distributor, Woodslane Pty Ltd, of 2/315 Barrenjoey Road, Newport 2106. However copies should be available at all major and technical bookstores. (J.R.)

PCs, assembly language

PC ARCHITECTURE & ASSEMBLY LANGUAGE, by Barry Kauler. Second edition, published by Karda Prints, 1991. Soft covers, 294 x 210mm, 246 pages. Recommended retail price $26.95, plus $7.00 for optional companion disk.

Many of our readers use IBM-compatible PCs of one type or another, no doubt because they're widely available at attractive prices. Their 'open' architecture also makes them very suitable for interfacing with a wide variety of other equipment.

For a lot of PC applications in electronics, you can often 'get by' using either commercially available software or with a 'quick and dirty' program written in BASIC. But for applications which need the PC to operate at full speed, or which are a bit specialised, there's no real substitute for programs written in assembly language. The only problem is that learning to write in assembly language is not easy, because it requires a good understanding of the way in which the 'guts' of the computer actually work.

Of course there are many books available on 8086/-88/-286/-386 assembly language programming. Some of them are quite good, and some just OK. But all of them involve a fair bit of work on the part of the reader — probably inevitable, because of the nature of the subject. No matter who the author, and how gifted, assembly language programming is never likely to be made into light bedtime reading...

This latest addition to the range of books on the subject is by Barry Kauler, a lecturer in the Department of Computer Studies at Edith Cowan University in Mount Lawley, WA. Barry's a very enthusiastic chap, and has written a few articles for *EA* in the past on various electronics subjects.

This book is his latest project, which I gather grew from his course lecture

notes. And it's very different from most, if not all other books on the subject, because it's written in the same programmed-learning 'hypertext' format used in computer database systems. The kind of scheme where you jump back and forth to suit your progress and needs, rather than reading in a linear fashion as with a conventional book. Barry claims that this 'reader-responsive' approach makes the book far easier to learn from than a conventional book, and it's apparently been a big hit with his students.

To go with the book itself he has produced a companion diskette, with a database providing most of the reference information of the book, plus a demo version of a hypertext management program he has written called BROWSE.COM, to access the database. BROWSE.COM can be either run in the usual way, or installed as a memory resident pop-up 'TSR', so that it can be called at any time while you're using a word processor, assembler or other program. The companion disk also includes copies of A86/D86, a powerful shareware assembler/debugger combination, and source listings of most of the programming examples given in the book.

Incidentally Barry Kauler also has another disk available, with the 'Softbook' hypertext development software he has

(Continued on page 125)

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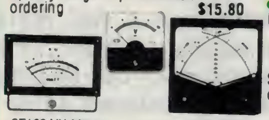
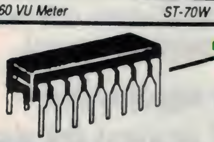


ST160 VU Meter — ST-70W



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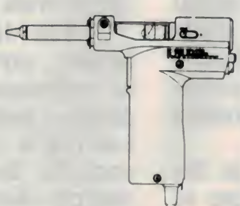

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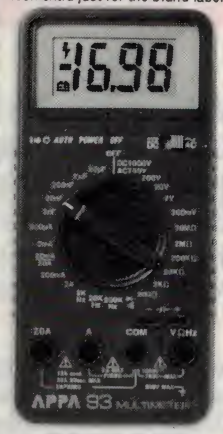

See Review in this issue!

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Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
Frequency 2kHz, 20kHz, 200kHz
Capacitance 2nF, 20nF, 200nF, 2μF, 20μF
Also available with transistor tester in place of capacitance ranges, (Model 93T) **$142.80**

Model 96

- 3 1/2 digit plus 41 segment analog bar graph
- Autoranging or manual selection
- 6 functions - Vdc, Vac, Adc, Aac, Ohms, Diode
- Water resistant
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
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Model 98

- 3 1/2 digit plus 41 segment analog bar graph
- Autoranging or manual selection
- 8 Functions - Vdc, Vac, Adc, Aac, Ohms, Diode, Frequency, Capacitance
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
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This is an MS-DOS software and cabling package which enables technicians and engineers to perform serial data comms analysis. It offers sophisticated problem solving facilities at a fraction of the cost of dedicated hardware systems. SerialTest provides a window onto RS232 lines operating either as a passive observer or actively sending data or control signals to simulate either at DTE or DCE device. Triggers can be defined based on error conditions or data to initiate or terminate monitoring sequences.

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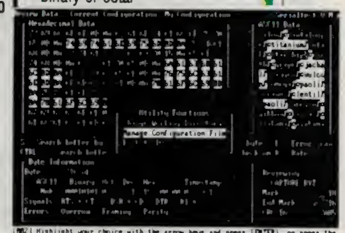
- View each byte in ASCII or EBCDIC, decoded to hex, decimal, binary or octal



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- CRC checksum calculations
- Auto-configuration to any of the comms ports 1 to 4
- Time-stamping (absolute and relative) including delta time calculations
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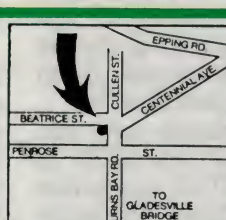


SUPPORT WORLD WILDLIFE FUND AUSTRALIA

NI's 'LabVIEW 2" software used in

AIRBORNE RESEARCH ON SUPERCONDUCTORS

A few weeks ago, scientists from the USA's Los Alamos National Laboratory and Houston-based Space Industries International carried out important tests on high temperature superconducting materials, while flying under almost zero-gravity conditions in a NASA research aircraft at an altitude of over 10km. As each test lasted only 20-25 seconds, a computer was used to provide essential monitoring and control — and the special software used was developed using the newly-released Version 2.1 of National Instruments' 'LabVIEW 2' graphical programming software.

When high-temperature superconducting materials or 'HTSCs' were discovered in 1987, they generated a great deal of interest and speculation.

Since then research organisations around the world have been spending a lot of effort carrying out further investigations on HTSCs, in the hope of discovering a way to produce materials that will be superconducting not just at 'high sub-zero' temperatures, but hopefully at normal room temperatures.

If that could be achieved, HTSCs could be used to achieve enormous breakthroughs in energy distribution, transportation, power generation and a host of other key industries.

Currently Space Industries International of Houston is working with the Los Alamos National Laboratory in New Mexico and Calspan, Inc., to investigate the effects of processing HTSC materials under near-zero gravity conditions.

The organisations have developed a compact *sheet float zone furnace* (SFZF), which is small enough and light enough to be used in NASA's Reduced Gravity Flight Programme. This uses a modified Air Force KC-135 aircraft flying in a parabolic path at high altitude, to provide a near-zero gravity environment for approximately 20-25 seconds at the top of each arc — for a fraction of the cost of a trip in the Space Shuttle.

A three-person research crew can co-ordinate the use of the SFZF to melt batches of HTSC materials during the KC-135 flights, timing the melting so that critical processing occurs during the 'zero G' periods.

Solidification in the absence or near-absence of gravity can result in materials with different microstructures from those processed in a similar way on earth, according to Donald Pettit, a research schientist at Los Alamos.

The KC-135 flight parabola lasts for 70 seconds, but the sequence is repeated some 40 times each flight day, giving a total of 13-16 minutes of 'zero-G' conditions each day.

The recently discovered class of HTSC materials (such as yttrium, barium, copper, oxide) are ceramics and, like many materials, polycrystalline. Their microstructure is determined by the size and shape of crystals and how they interlock.

"The materials we are zeroing in on for the parabolic flight project," Pettit says, "are those whose useful properties come from their microstructure. The useful electrical properties of high-temperature superconducting materials are dominated by microstructure."

Gravity plays a subtle role in the formation of the microstructure of HTSC materials, says Pettit, because these ceramics contain crystals of different densities.

"If you had a material that was homogenous — crystals of all the same density — you wouldn't expect a significant difference when you solidified it in zero gravity. On the other hand, with materials such as these ceramics where there are density differences, you can expect to see some changes when you solidify in zero gravity."

Zero-G may allow scientists to produce composite materials such as mixtures of superconductor ceramics and silver. While silver has a density of 10.5 gr/cc, superconductor ceramics have a density of approximately 6.3 gr/cc.

When brought to a full melt on earth, they rapidly separate. In zero gravity however, they can be brought to a full melt and maintain a fine dispersion of silver within the matrix of the superconducting material.

On-board equipment

The SFZF is about the size of a washing machine. It uses four movable quartz halogen lamps to focus heat in a narrow band along a sample which can be up to 2.5mm thick by 75mm wide by 100mm long.

These lamps make powerful heaters, says Paul Brannon, manager of information systems at Space Industries and primary developer of the LabVIEW 2-based programme that controls the furnace for HTSC research aboard the KC-135. Many samples can be heated from ambient temperature to melting temperature in less than 10 seconds.

Ice water is circulated within the furnace walls to keep them at a constant, cool temperature. "My flight seat is actually an 80-quart ice chest," says Brannon. "During a flight, that entire amount of ice is melted."

The Space Industries Sheet Float Zone Furnace which is used for high temperature superconductor materials processing research in a microgravity environment aboard the NASA KC-135 parabolic aircraft. LabVIEW 2 controls the Macintosh based system.

Typically, a sample is preheated as the plane goes through its 2-g pullout. During this phase, heaters move up and down along the material, bathing it in infrared energy and bringing it close to melting.

As zero-g begins, the heaters are brought close together, doubling the heat flux to the centre of the sample and establishing the melt. The heaters are then moved slowly apart to spread the melt along the sample's length in both directions.

As soon as the focused energy leaves an area, the material begins to solidify. Solidification occurs between two separate melt fronts, an area called the 'float zone' where the desired large crystals can be formed.

Approximately five seconds before gravity returns, the lamps are shut off to allow the material to completely solidify. As the plane descends, g-forces increase and at pull-out into the next parabola, the plane and its payload experience up to 2-g's.

Computer control

An industrialised Macintosh IIx computer running LabVIEW 2 software from National Instruments controls the movements of the heaters, by sending signals to a programmable stepper motor system. The computer system also sends an 0-5 volt signal to an SCR power controller which regulates the electrical power to the heaters.

Brannon designed the computer system to be easy to use in flight. Aboard a plane that's continuously climing and diving, Brannon would have little use for a Macintosh and LabVIEW was because he could design a control screen that used graphics rather than text. For example, large buttons at the bottom of the computer screen represent the commands that control the heaters.

When zero-g hits and it's time to bring the heaters together to establish the melt, Brannon simply touches the button marked 'melt.' (The computer is equipped with a touch screen. A trackball is along for back-up and although the keyboard is also on-board, it is not normally used.)

LabVIEW 2 controls a plug-in board that sends signals from the computer that cause the stepper motor to carry out movement sequences which were programmed before the flight.

"One day, we" just press a 'Go' button and run through the whole process," says Brannon, "but for now, since we are still experimenting with new materials, I take the heaters through step by step. For some materials, for example, we'll need to spread the heaters more slowly. Some we'll need to melt a little longer. As we learn more, we will automate the process more."

In addition to controlling the furnace, the same computer system displays experimental parameters in real time and also records them for later analysis.

Post-flight review is a critical part of the research protocol because the plane flies for three consecutive days.

Modifications and changes in parameters can be made after each of the first two flights to ensure that the experiments are successful.

Video included

To supply researchers with the most comprehensive coverage of the experiment possible, Brannon added an off-the-shelf VCR and camera to the computer system.

During flight, a video image of the sample in the furnace is displayed on the same screen as the LabVIEW 2 screen display, which also has numerous processing parameters and control switches.

The video and screen images are merged and transformed to an NTSC signal by a Color Space II video board installed in the Macintosh IIx. NTSC output is recorded on the VCR.

Researchers can replay the videotape and see what happened in the furnace as well as evaluate the data that was displayed on the computer screen during flight. They also receive a print-out of all data, and can stop the videotape at any point, go to that spot in the data file and find more information.

The extensive data analysis capabilities of LabVIEW 2 can also be used at any time for processing and analysing acqired data.

Optical pyrometer

Perhaps the most important piece of experimental equipment from the standpoint of scientific credibility, is an optical pyrometer, says Bill Fraser, Space Industries project manager for the Sheet Float Zone Furnace.

Before last June, no temperature data was available. "We could visually determine that the sample was melting. But we had no way of knowing the actual sample temperature," he says.

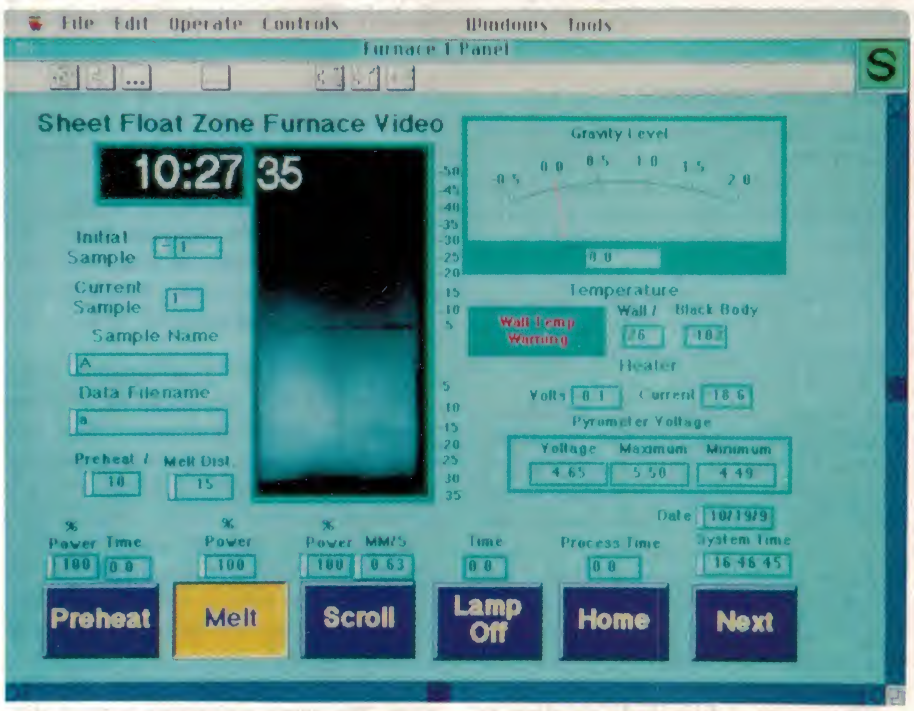
Optical pyrometry was chosen because this method determines temperature without touching the object.

"Foreign materials coming in contract with HTSC material can cause contamination," Fraser explains. The pyrometer is custom-made by Calspan Corp.

It differs from most pyrometers in that instead of focusing on a single point of the sample, it scans the length of it, giving 200 data points per second. "By following the data stream," says Fraser, "we can tell the temperature of the different parts of the sample."

The pyrometer works by looking at the infrared wavelength of 5 microns. As a material is heated, it gives off energy and the hotter the sample gets, the more 5-micron energy it puts out. Through curve-fitting mathematics, 5 micron energy is converted to temperature.

This conversion is currently performed after the flight, but Brannon eventually plans to insert formulas for each type of sample material into LabVIEW 2 and using the software's data analysis routines, convert wavelength data to temperature during the flight.



The LabVIEW 2 graphical programming software which is used to control the Sheet Float Zone Furnace during micro gravity flight. The large command buttons at the bottom control the heater activity.

More accessible

According to Space Industries, the primary benefits of performing superconductor research using parabolic flight instead of the Space Shuttle are economic and ease of quick access.

"Equipment designed to fly in space required extremely high reliability and therefore is expensive to design and build," says Fraser. "Access to space flight is so infrequent and expensive that the high reliability is mandated. Therefore, space-based experimentation is a very expensive prospect."

"Since flights on the NASA KC-135 are more accessible and several orders of magnitude less expensive than space-based flights," continues Fraser, "equipment does not require such high reliability (even though safety considerations are just as stringent). Therefore equipment costs are substantially lower and the cost per sample or per experiment run are probably lower by at least three orders of magnitude."

In addition, parabolic flight offers researchers more control over their experiments. "In space, many factors are not in control of the experimenter," Brannon says.

"On the other hand, we fly one day, look at the videotapes and samples that night, make some modifications in processing parameters, and fly again the next day. That's the beauty of the KC-135. You fly again the next day. You don't have to wait years to make a correction and try again."

About LabVIEW

LabVIEW is a general-purpose programming tool that has been in use by engineers and scientists since April 1986 for developing data acquisition, data analysis and instru-

ment control applications on the Macintosh. LabVIEW 2, the new compiled version, generates machine code that executes at speeds comparable to those of compiled C programs.

LabVIEW 2 offers the significant productivity gains of a graphical programming environment without sacrificing the performance found in conventional languages. In LabVIEW 2, software programs are called virtual instruments (VIs). VIs have a graphical front panel user interface and a block diagram program.

The front panel (which can be customised with a variety of controls and displays such as knobs, slides, switches, graphs and strip charts) serves as an interactive interface for supplying inputs and outputs.

The block diagram is created by connecting executable blocks (or icons) with wires that pass data between the blocks, rather than by writing sequential lines of conventional programming code.

LabVIEW 2 features extensive, ready-to-use libraries for data acquisition, signal processing, numerical analysis, data presentation, motion control and process control.

The new LabVIEW 2.1 Run-Time system is an economical way to distribute LabVIEW 2 VI's in a multi-user environment. This compact, operate-only version of the software is tailored to end users and VARs who want to run ready-to use programs in turn-key data acquisition systems.

With the run-time system, operators can load and execute VIs, change the value of controls and observe the values of indicators. However, operators cannot look at or edit the VI block diagrams, thus protecting source code from changes.

National Instruments Corporation, headquartered in Austin, Texas since 1976, is a leading producer of hardware and software products for instrument control and PC-based data acquisition, analysis and presentation. The products are used by engineers and scientists for laboratory automation, data acquisition, processing monitoring and control, physiological monitoring, personal instrumentation and automated testing.

For more information about LabVIEW 2 circle 201 on the reader service coupon or contact Elmeasco Instruments, 18 Hilly Street, Mortlake 2137; phone (02) 736 2888. ■

NEW BOOKS

(Continued from page 120)

developed and used to produce the current book. The idea is that other authors can use the same system to produce similar hypertext books.

As for the current book and its optional companion disk, they certainly provide a detailed and comprehensive introduction to assembly language programming for the IBM-compatible family of PCs. For the asking price they're also excellent value for money, and much cheaper than most of the other books available on the same subject.

Whether you'll find them easier to learn from than a conventional book is likely to be a matter of personal choice, though. Probably I'm revealing my age and conventional book-orientated education, but I have to admit that I found them rather confusing. To me much of the text in the book seems terse, and in need of further explanation. I also find the 'if you want to know X, jump to here' and 'to learn more about Y, jump to there' approach very distracting, and disruptive of my assimilation of the subject information. But if you're into this modern 'modular' approach to learning, your reaction may well be the exact opposite.

The book and optional companion diskette are available direct from Karda Prints, of 10 McCormick Way, Narrogin WA 6312. The prices shown include post and handling, but only apply until the end of June 1991; after that they are likely to rise. Note that the optional diskette is not available alone; you can either buy it with the book, or later by using an order form included in the rear of the book. The Softbook development software diskette is also available from Karda Prints. (J.R.) ■

THE SERVICEMAN

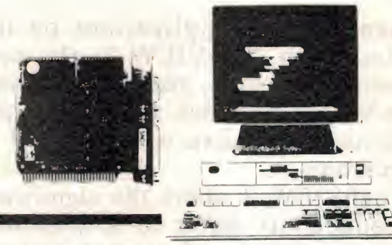
(Continued from page 49)

ting the 30V rail in some way. The thing is even morefrustrating when I consider that I'd checked both rails (60V and 30V) several times, and found nothing amiss. But each time I'd checked them at convenient points on the power supply, which were 'upstream' from the faulty fuse.

If I'd made the check at the input to the line board, I might well have found the fault sooner. But by no stretch of the imagination would I have suspected the fuse, even if I had known that the fault was on the power supply board.

I don't know what I'll have for you next month, but I doubt whether it will be as obscure as this one has been! ■

Computer News and New Products



Easytrax for the Macintosh

Easytrax for the Mac, Protel's first product for the Macintosh engineering marketplace is now available worldwide. Easytrax for IBM-PC and compatibles has been available since January 1989.

Easytrax, a dedicated printed circuit board design package, provides all the software tools required for board layout and artwork generation. The package is optimised for through-hole design work and includes a component

library of standard component patterns. Gerber plot, pen plotting and numeric controlled (N/C) drill output capabilities are standard. Features include a switchable metric/imperial grid system with a resolution of .001" (0.25mm), pad to pad autorouting of traces and automatic Bill of Material generation.

The Macintosh version of Easytrax has all the design capabilities of the DOS-based version, but has been completely rewritten to conform with Mac human interface guidelines and offers a number of productivity advantages provided by the highly standardised Macintosh user interface. The program is priced at $495 and is targeted at prototype/short-run PCB production, students and electronics hobbyists.

User files and libraries can be swapped between Mac and DOS versions of Easytrax at any time and an upgrade path is maintained to Protel's fully-automated Autotrax professional PCB design system.

A fully functional demonstration version of Easytrax is available on request from any Protel dealer.

For further information circle 163 on the reader serv ice coupon or contact Protel Technology, GPO Box 204, Hobart 7001; phone (002) 73 0100.

Thermal wax colour printers

Tektronix has released its Phaser II series of second generation, colour thermal wax transfer printers. The family of six printers offers the broadest range available of high-quality output solutions for virtually all business environments, including Macintosh, PC, workstations and now IBM mainframe. Prices range from $8495 to $19,996 excluding sales tax.

All printers in the family have 300dpi colour output with modular configurations that can be expanded and adapted to users' changing needs. The printers are able to output virtually unlimited colours and also include multitasking connectivity, large transfer ribbon capacity, sheet-fed media, quiet operation, tester reliability and a small footprint.

The Phaser II series is targeted at the rapidly growing market for high-quality colour business graphics, particularly overhead presentations, in mixed-use offices. These may have IBM PCs and compatibles, Apple Macintosh personal computers, workstations, minicomputers or mainframes. In addition, it serves engineering/scientific, graphic arts and desktop publishing applications.

The printers combine low cost and high performance by using a memory efficient controller and by relying ont he host computer for image processing. Drivers are available for both IBM PC and Macintosh platforms, with transparent printer sharing across local area networks. Both Postscript and Hewlett-Packard Graphics Language (HP-GL) are supported for easy connectivity to almost any host or application.

For further information circle 172 on the reader services coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.

Ethernet interface card

Integrated Networks has released another product for MultiNet LAN connectivity. The LEC-45T is a 10BaseT-compliant Ethernet Interface Card with an on-board 10BaseT transceiver. PC workstations equipped with this interface card no longer require an external transceiver in order to interconnect to Multinet hubs and other 10BaseT-compatible node connections. The LEC-45T is a compact, half-sized board compatible with the

Price cut for HP LaserJet

Hewlett Packard Australia has slashed the list price of its HP LaserJet IID laser printer from around $7000 to $4310.

HP claims that it has substantially undercut even discounted 'street prices' of any HP LaserJet IID look-alike products on the Australian market.

The HP IID printer features dual bin operation allowing letterhead and following paper, for example, to be loaded at the same time.

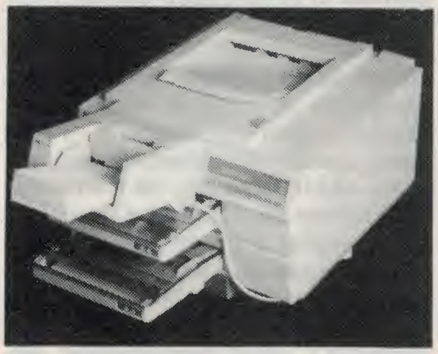
An optional envelope feed allows envelope, letterhead and follower to all be printed and collated automatically.

The printer also features duplex (double sided) printing to halve office paper costs.

The IID printer was superseded recently with the introduction of the LaserJet IIID printer, with the added features of typeset-quality Resolution Enhancement Technology and PCL 5 language that provides enhanced font handling and grapics capabilities.

The HP LaserJet IID printer was the top selling dual bin laser printer in Australia for 1990, according to IDC.

For further information circle 165 on the reader services coupon or contact Hewlett Packard Australia, 31-41 Joseph Street, Blackburn 3130; phone (03) 895 2946.



Sharp's computer projection panel

Sharp Corporation has released its new projection panel, the QA- 75. The panel is easy to use. It is simply connected to a personal or business computer and placed on an overhead projector.

Because of the QA-75's lightweight and optional carry-case, it is ideal for use with a laptop portable computer. Text, graphics and charts are all displayed onto a big screen with excellent clarity, even to a large audience. Presentations can be pre-programmed on your PC and then be displayed on the spot.

Some other features of the QA-75 are its compatibility with IBM, Macintosh and Apple II series computers, and compatibility with all common display systems. The triple supertwist LCD screen provides very good contrast on its 640 x 480 dot screen, while the 1:1 aspect ratio gives a square image. Other features include screen freeze, screen enlargement and an on-screen pointer. Costing $2495 including tax, the projection panel is designed to replace traditional slides and overhead transparencies for people who make presentations as a part of their business.

For more information, circle 161 on the Reader Services Coupon or contact Sharp Corporation, PO Box 827, Blacktown 2148; phone (02) 831 9111.

IBM PC,XT, AT, 386, PS/2-25/30, as well as most clones.

The interface card allows for implementation of multi-media, enterprise-wide, cascading Ethernet networks, with diameters of over four kilometres. It is equipped with an RJ45 connector, as well as a standard IEEE 802.3 AUI interface, to enable use of the card with existing non-10Base T networks.

In addition to performing the standard IEEE functions, the card also has an automatic link polarity detection and correction feature. Increased diagnostics include a user-selectable 10BaseT Plus mode, which allows detection of transmit link failure.

For more information, circle 162 on the Reader Services Coupon or contact Integrated Networks, 26 Tepko Rd, Terrey Hill 2084; phone (02) 486 3066.

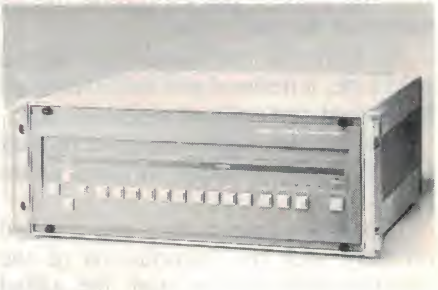
Scan converter for computer video

Chromatek Advanced Video Lab has produced the Model 9120, a real-time scan converter that converts video signals from personal computers and workstations to broadcast standard signals, NTSC or PAL. With the wide input range of 15kHz to 128kHz (optionally extendable to 240kHz), the 9120 is a professional scan converter which enables computer-generated graphics to be used for broadcast video sources.

Extremely easy to use, the 9120 can accept video outputs from personal computers through to high quality graphic superworkstations. These input signals are measured automatically, and if necessary, the Chromatek 9120 adjusts the conversion to achieve the sharpest picture quality. This facility allows the user to convert computer images to standard video tape without the need to know the computer's video specifications. Besides the composite signal for NTSC or PAL, the 9120 outputs RGB signal, Y/R/B-Y luminance/colour difference signals and the Y/C signals of NTSC, simultaneously.

Included as standard features are a 'montage' circuit for making composite pictures, a 'gen-lock' circuit for phase matching studio sync signals and the 9120 output sync signal, and a comb filter for colour cross-checking.

For further information circle 168 on the reader service coupon or contact Anitech, 52/2 Railway Parade, Lidcombe 2141; phone (02) 749 1244.



Enhanced circuit analysis package

The third and enhanced version of Spectrum Software's very popular electronic circuit analysis package 'Micro-Cap', is now available in Australia.

Micro-Cap III offers faster analysis and simulation than either previous versions or competing packages, having been re-written in C and assembly language.

As with the previous version, it offers the ease, speed and convenience of window-based operation, together with a fully integrated schematic editor. Analysis and simulation are via SPICE-like routines, directly from the entered schematic.

Combined digital/analog circuit simulations are made possible by integrated switch models and parameterised macros. Models provided now include nonlinear magnetics, MESFETs, transmission lines and nonlinear function sources.

Micro-Cap III's extended routine list includes impedance plots, Nyquist diagrams, B-H plots and Monte Carol statistical analysis. Algebraic formula parsers allow plotting virtually any function. Micro-Cap III supports Hercules, CGA, MCGA, EGA and VGA displays and provides output for plotters and laser printers. Cost of the full Micro-Cap III package is $1850, while an evaluation version is available for $200. The earlier Micro-Cap II version is still available also, for $1100 (evaluation version $130).

For more information circle 180 on the reader service coupon or contact David Spalding Pty Ltd, 45a Blacket Drive, Castle Hill 2154; phone (02) 639 3507.

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PCB PATTERNS: High contrast, actual size transparencies for printed circuit boards and front panels are available.

Price $5 for boards up to 100 square centimetres. $10 for larger boards. Please specify positive or negative.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only, and to projects less than five years old. Price $5. Please note that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

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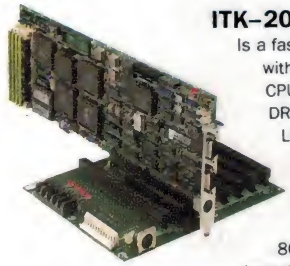
Our Solid State Disks will drive your PC like a Porsche.



ITK–201
Is a fast 286 Industrial Slot Board with a 16MHz 80C286 CMOS CPU. 1 to 4 Mb of zero wait state DRAM with full parity checking. LIM expanded memory support. Two Serial ports one of which may be configured for RS422/485, Centronic Parallel Port, Real Time Clock, AC and DC level detection, 80287 Socket. Low power consumption – less than 10W, rated 0 to 60 degrees Celsius.
From $750 ex tax with 1Mb RAM.

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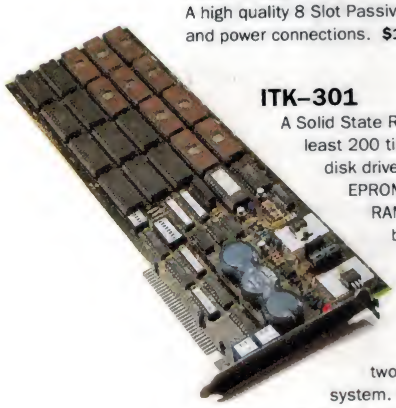
A high quality 8 Slot Passive Backplane with keyboard and power connections. **$100 ex tax.**



ITK–301
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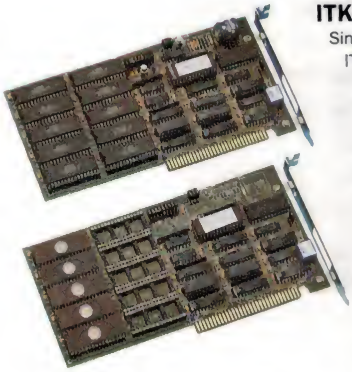
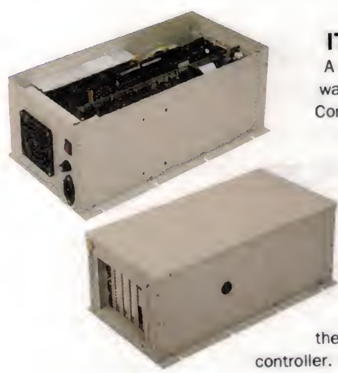
$489 ex tax plus EPROM/RAM devices.

The ITEK range of industrial products will give you fast, reliable performance that won't stop your cash flow.



ITK–302 A/B
Single Drive RAM/ROM disks. ITK–302A takes up to 1.2Mb EPROM or 1.2Mb SRAM (battery backed). ITK–302B accommodates up to 1.2Mb EPROM. Both boards accept 28 or 32 pin devices and emulate floppy disk drives A:, B:, C:, or D: in 320Kb, 360Kb or 1.2Mb format. Software support provided, Auto Bootable. Fast and small – ideal for industrial work.
ITK–302A $207, 302B $185 ex tax plus memory devices.



ITK–401A
A compact enclosure suitable for wall, panel or table mounting. Contains a 95 watt PSU (220VAC) and a 6 Slot AT Passive Backplane. The unit includes a 30CFM cooling fan, fuse and reset button. The ITK–401A is about the size of a shoebox allowing installations on the factory floor or inside NEMA enclosures. OEM's will find the unit ideal as an embedded controller. **$760 ex tax.**

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